METAL FINISHING

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An article on the factors of importance in selecting an electrodeposited metal coating where subsequent assembly by welding, soldering, or brazing is involved.

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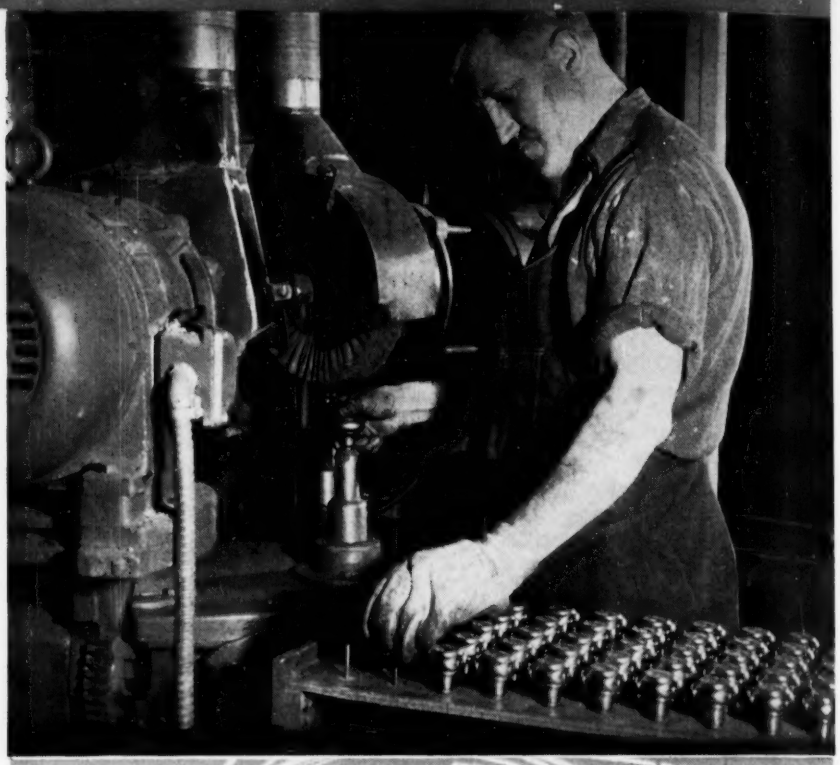

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Want To Be A Good Cook?

The reputation and value of a good chef is established through his ability to consistently concoct attractive and appetizing dishes from the same assortment of basic ingredients that less talented cooks never seem to endow with any originality. It is a matter of intense pride with these satisfiers of Epicurean appetites that their favorite recipes are for the most part committed to memory, and the mere mention of a cook book would most likely set off an invective explosion in some foreign language. As a matter of fact, very few of the precious secrets of the masters' art would be entrusted to the printed page.

The master plater and metal finisher, however, must necessarily operate on a different basis than these "Oscars of the Waldorf". With today's rapid developments in formulae, techniques and equipment in the metal finishing industry, even the "masters" of the trade know that they could not hope to keep an adequate supply of the available knowledge in their heads, and have learned through experience that the next best thing to a prodigious memory is an up-to-date, practical and complete reference manual.

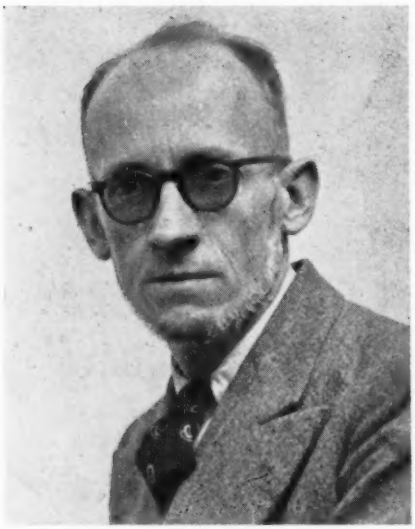
We are proud of the fact that for many years the "Platers' Guide", and more recently the Guidebook-Directory for the Metal Finishing Industry has served just such a purpose—the "cook book" of the plating industry, helping the "chefs" in no small way to turn out an attractive and satisfactory "dish" to a demanding and appreciative consumer. (We hope that none of the "chefs" will be tempted to take a sample taste of any of the recipes, however.)

This year's 18th Edition of the Metal Finishing Guidebook-Directory, available about August 1st, will carry on the important work of its predecessors. Each article has been revised to include the latest available data, and many new articles have been added; Bright Copper Plating, Design and Construction of Plating Racks, and Alkaline Cleaning, to mention a few. The popular section on Plating Plant Engineering has been retained and supplementary material added.

To those who are familiar with previous editions of this manual we can only advise waiting patiently; those who have not seen nor used it are respectfully advised to do so.

Electrolytic Polishing of Metallic Surfaces—Part I

By Dr. Pierre A. Jacquet, *Ingénieur-Chimiste I.C.P., Docteur de l'Université de Paris, France.*



The Author

Dr. Jacquet is one of the world's outstanding electrochemists, and is widely acclaimed for his discoveries and developments in the field of electropolishing of metals. He received his Chemical Engineering and Doctor's degrees at the University of Paris. From 1928-1937 *he carried on research on the structure and properties of electrodeposited metals at the research laboratories of La Societé Le Materiel Telephonique and the Laboratoire d'Electrochimie de l'Ecole Pratique des Haute Etudes. He has also been associated with Prof. Joliot-Curie at the Laboratorie de Chimie Nucleaire du College de France. Since* 1945 *he has been connected with the French Navy as Ingénieur Contractuel, and has been Scientific Collaborator for the National Office for the Study of Aeronautical Research (France). Dr. Jacquet is the author of more than* 80 *articles in the scientific and technical journals of the world, and is the Sixth Weston Fellow of the Electrochemical Society (U.S.). He has also received the Robin Prize of the French Society for the Encouragement of National Industry.*

In this, the first in a series by this world famous scientist, the fundamental phenomena accompanying the electropolishing of metals are explained. Succeeding articles will take up the applications and future possibilities of this important industrial process.—ED.

Introduction

THE scientific and technical literature now dedicated to electrolytic polishing of metals has reached an impressive volume (about 400 references and more than a hundred patents). In the laboratories of the entire world an ever growing number of metallurgists, physicists and chemists are using this new procedure for preparing surfaces, and are discovering new applications which were more or less unexpected. The factories and plants have a large call for it to be used for the finishing of manufactured products, and most recently its use as a pre-treatment before its transformation into finished products.

In the numerous publications in American, English, French, Italian, Russian, etc., the exposure of the known data is excellent and very well documented. However, it is apparent that the authors are following the tendency to develop particular points of view. Some are interested in the scientific aspects and others in industrial problems; certain of them describe in detail the composition and working conditions of electrolytic polishing without emphasis on its applications, and vice-versa. This specialization is, however, normal and obligatory at the time when a technique is starting in its infancy to enter into a mature world. Now electrolytic polishing is attaining its goal.

Without preparing a large book, no one has had the ambition to write an article on electrolytic polishing which is at the same time both detailed enough and general enough to teach the specialist new developments of which he is ignorant, and to interest also the

man in the laboratory and the engineer who are only interested in the general principles and the possibilities of the new process.

Without pretending to attain this double but inaccessible goal, the present articles are primarily a philosophy, or to use the word of the time, a digest of electrolytic polishing.

One important part of the paper will be devoted entirely to the principles and to the mechanism of electrolytic polishing, for the possible perfecting of the process depends almost entirely upon a knowledge of the fundamentals.

The Discovery of Electrolytic Polishing

About 1920 the processes of pickling and cleaning steel surfaces by electrolytic methods were known; generally they were processes involving alkaline or sulfuric acid solutions. This technique was the subject of a number of patents, principally of American origin[1], but not one publication of a scientific character. For example, in 1925 *Madsen* claimed in a patent that an adherent nickel deposit could be put on steel thanks to an anodic pickling in concentrated sulfuric acid under a current density of 95 A/ft^2. In 1928 *Burns and Warner* patented the use of a phosphoric acid bath for anodic pickling of steel and they noticed that under certain conditions the surface acquired a brilliant luster. Many other patents describe analogous processes, in which the development was due primarily to the increasing use of electrolytic coatings, depending upon careful treatment of the base metal.

Like many inventions, the discovery of electrolytic polishing was the result of a happy chain of circumstances. In the year 1929, being a young engineer in the research laboratories of the *Societe Le Materiel Telephonique* (affiliated with the *International Telephone and Telegraph Corp.*), the author had solved the following problem: realization of the perfect polishing of thin nickel foil rolled in the form of a cylinder, without resorting to the customary mechanical polishing methods. The latter method was very difficult because of the thinness of the metal on the one hand, and because of the proposed application (screens entering into the manufacture of very powerful radio tubes), where all contamination of the surface of the nickel by the polishing agents was detrimental. We had personally had the opportunity, during a session at the electrochemical laboratory of l'Institute de Chimie de Paris, to notice an effect of polishing of very fine copper wires used as electrodes in mixtures of phosphoric and perchloric acids and organic solvents. This study was quickly oriented towards the problem and converted to a purely electrolytic polishing method, the metal playing the role of the anode in a suitable bath. After a considerable number of attempts in which the chief of the laboratory, *H. Figour*, collaborated, satisfactory results were obtained and divulged in a patent issued in France on March 14, 1930.[2] This patent describes the polishing—first, of nickel in an electrolyte composed of perchloric acid (210 cc.) in solution in acetic acid (790 cc.),—second, of copper in a mixture of phosphoric acid and ether,—third, of molybdenum in concentrated sulfuric acid. It also disclosed the possibility of polishing other metals such as aluminum and lead in these electrolytes, and stressed the importance of the anodic current density, which should not descend below a minimum value. From the historical point of view, it is important to emphasize that this patent contains, in substance, all of the elements actually known of electrolytic polishing techniques (baths containing one or more of the acids—sulfuric, phosphoric, perchloric, acetic, in the absence of water or, at least, in solutions of very high acid concentration). The use of anodic current densities distinctly higher than those necessary for the cathodic deposition of the metals is also disclosed.

Since then the new process has been used on an industrial scale in the manufacture of radio tubes by the Society L.M.T. and its associated companies, particularly for the polishing of nickel screens and molybdenum rods, but further research in the laboratory is not being carried on.

The patent reviewed above showed for the first time the possibility of polishing objects of large size without resorting to the use of mechanical methods, which were until then the only ones available. However, it appears that it passed almost unnoticed. Bibliographical references only mention it rarely, but one can consider that it inspired more or less a certain number of industrial applications.

A patent of *G. B. Hogaboom* of July 5, 1932 describes under the title "Electrolytic Bright Dip for Iron and Steel," a method of anodic treatment of steel in sulfuric acid under high current density, which produced a brilliant surface and which was attributed by Hogaboom to the formation of persulfuric acid. A little later, in 1933, the *Aluminum Company of America* patented, under the name of the "Alzak Process," the electrolytic polishing of aluminum by anodic solution in a bath of aceto-fluoboric acid. In 1936, which was after our laboratory research published in 1935, the *Aluminum Company of Britain* patented on its part, the process "Brytal," which was the anodic polishing of aluminum in an alkaline medium. Contrary to what one might think, the industrial applications of electrolytic polishing have preceded the theoretical and experimental laboratory studies by several years.

Strictly speaking, however, the processes patented were concerned with higher polishing of surfaces, for their principal aim is to augment the polish on a surface already bright enough, and not to eliminate deep scratches. Further, it is known that the Alzak and Brytal processes are applicable only to very pure aluminum.

The systematic research of the author on electrolytic polishing started in 1934, when under the direction of *Prof. Charles Marie* at the laboratory d'Electrochimie de l'Ecole Pratique des Hautes Etudes, he studied the influence of addition agents on the prop-

erties of electrolytic deposits of copper. Here we should admit that ignorance and laziness are the fundamental causes of research! This small point of history deserves to be told. In order to explain the action of organic colloids on acid copper sulfate baths it was necessary for us to explain the small differences in the crystalline structure of the copper deposited at the cathode. Now that was an entirely new field, as we had never had the least occasion to use micrography. Armed with the traditional equipment (the discs of felt and cloth, emery paper and alumina, recommended at the debut of metallographic science by the illustrious chemist and metallurgist, *H. Le Chatelier*,) we spent long hours polishing our small samples of copper. The first results were scarcely encouraging: even when the nearly polished surface was etched immediately, the details of the structure never appeared with sufficient clarity. This dirty and tedious method of preparation seemed too barbarous to us to be perfected, and we remembered our old work at the Laboratoires L.M.T., which directed our research toward a purely electrochemical method. The goal sought was the following: to polish small surfaces of copper in a perfect manner after they had been roughed down with emery paper, by using a simple electrolytic cell controlled by a measuring apparatus. The result was attained quite quickly: the photographs published in our note to *Nature*[3] showing for the first time the reality of the phenomenon of electrolytic polishing. However, the process presented some inconveniences and was progressively perfected as we searched for a fundamental explanation of the process of electrolytic polishing.[4]

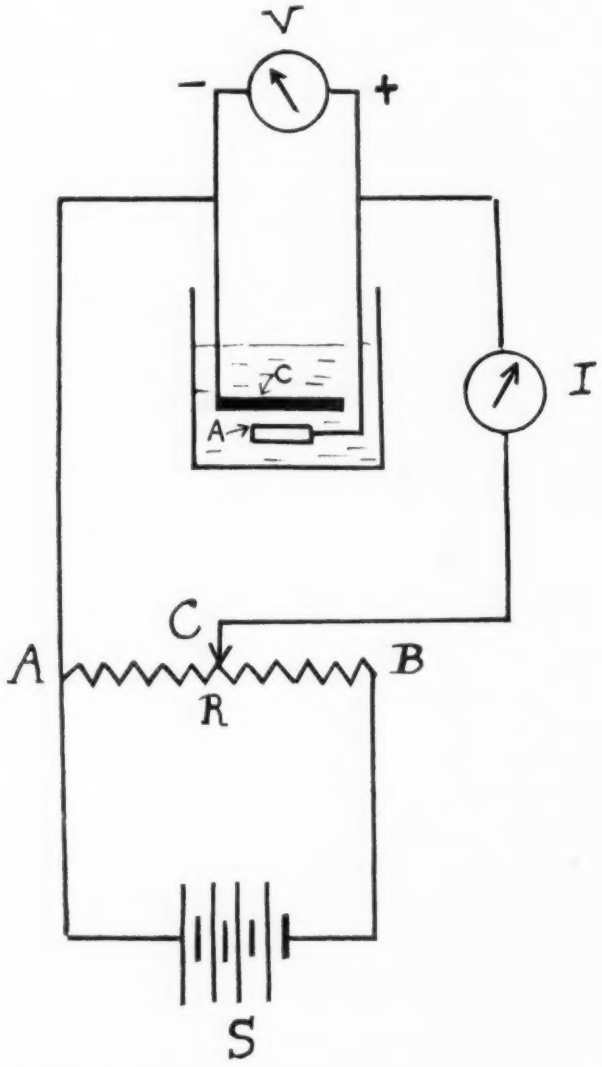


Figure 1. Schematic drawing of apparatus used for tracing Current-Voltage curves. Anode-copper; bath-500-1000 gm/l. H_3PO_4. (A) Copper anode; (B) Rheostat slide; (C) Copper Cathode; (I) Ammeter; (S) Source of Direct Current; (V) Voltmeter.

Starting in 1935 the electrolytic polishing of copper allowed us to solve micrographic problems where the most careful mechanical polishing had failed, which could be foreseen to be of general interest to metallography. Our work was directed toward determining the conditions for polishing other metals and to present the differences of structure and existing properties between surfaces polished electrolytically and mechanically.[5] At this point it is not without interest to recall that it was the physicists and not the metallurgists who were first interested in this new method of polishing; *Elmore* of the United States used it in 1937 for his studies on magnetism[6], *H. Lowery*[7] in England and *L. Capdecomme*[8] in France in 1936 and 1937 for their research on the optical properties of metals.

While the L.M.T. patent of 1930 marked the first publication describing a definite process of electrolytic polishing, the two notes to *Nature* and *The Academy of Science* in 1935[3,4] and the communication to the *Electrochemical Society* in 1936[4] made the method known to the scientific and industrial world. However, it is probable that electroplaters had the occasion to notice the polishing of the anodes long before this, for example in the case of silver plating, and especially in the stripping of nickel in sulfuric acid where this acid is particularly remarkable for polishing nickel at high current densities. These fragmentary observations never received attention however, and remained unnoticed.

Principals and Mechanism of Electrolytic Polishing

At present, fifteen metals and a certain number of their alloys may be polished electrolytically; these are aluminum, silver, cadmium, chromium, cobalt, copper, tin, iron and ordinary and special steels, magnesium, molybdenum, nickel, lead, tantalum, tungsten and zinc. In principle, all of the alloys composed of a single phase (solid solutions) attain a degree of polish equivalent to that of a pure metal, but as soon as we add the presence of one or more other phases the surface becomes more or less dull or rough. This is why, for example, that alpha brass (70-30) and the alloys of aluminum and magnesium can be polished as well as copper and aluminum, but alpha and beta brass (60-40), duraluminum, and "Y" alloy containing more than one constituent are all left more or less dull. It shows in effect, as we observed in the micrographic applications, that each phase of the alloy has a specific rate of solution at the anode. For the same

reason, all insoluble impurities in a metal can be detected at the surface after electrolytic polishing. Finally, the physical faults found most frequently in cast metals (pores, blowholes, cracks, etc.), are not only exposed but are even more or less exaggerated, for the anodic solution of the metal has a tendency to be accelerated around these discontinuities. This should be particularly taken into consideration when considering the substitution of the electrolytic method for the mechanical method of finishing metallic objects, as the latter method tends to mask these imperfections and defects, thanks to the flow of the surface layer of the metal. Nevertheless, the small chemical or physical imperfections are not always hard to remove, and some electrolytic polishing techniques are more apt than others to minimize their effects.

Current-Voltage Curves Characteristic of the Polishing Processes

Polishing is observed when the metal is connected as the anode in an electrolyte of the proper composition and is subjected to a current density held between certain definite values. Quite often the phenomenon is produced as a result of prolonged treatment at a minimum current density, but the quality of the polish obtained is apt to present marked variations. In spite of the fact that the current density is a fundamental factor, in a bath of a given composition and at a definite temperature, a strict relationship exists between the most favorable current and the potential at the terminals so that, all things equal, one is sometimes interested in considering the voltage as the true variable controlling the polishing effect.

We are thus led to examine the graphical relationship of current density and voltage at the terminals of the electrolytic cell. We discovered this relationship in the beginning of our research on copper. Many specialists are inclined to consider it as an essential characteristic of electrolytic polishing, since its apparent absence for certain metals and certain baths is now well explained.

Let us consider the polishing of copper or brass in a concentrated aqueous solution of phosphoric acid (500 to 1000 g/l. H_3PO_4). The potentiometric setup shown in Figure 1 allows progressive variations in the potential at the terminals of the cell starting with the value zero by shifting the slide C from point A toward point B. For each one of these positions of point C the values are read on the ammeter and voltmeter. The complete curve thus obtained shows several characteristic regions (Figure 2A).*

At the start there is a nearly horizontal part, without interest here. Then a rectilinear portion A B where the current increase is proportional to the voltage. When the current reaches a value of 8.5 A/dm² (79 A/ft²), a few oscillations are observed and then,

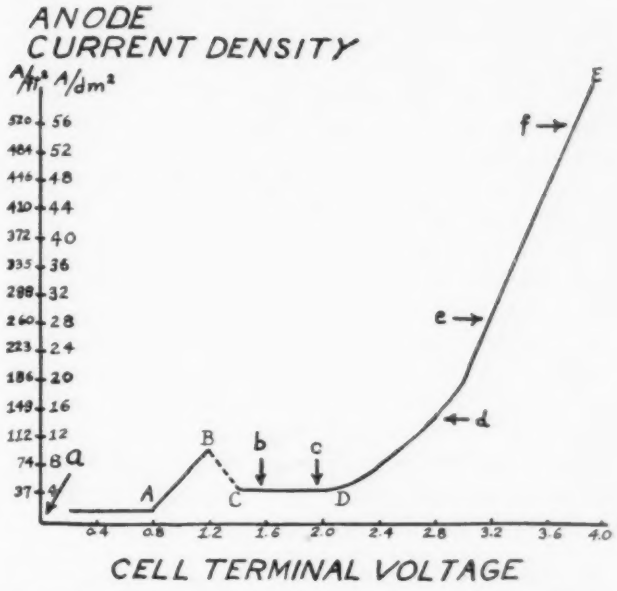


Figure 2A—Current-Voltage curve for a copper anode placed horizontally in a 600 gm/l. bath of H_3PO_4. See Figure 2B for corresponding surface structures at points indicated.

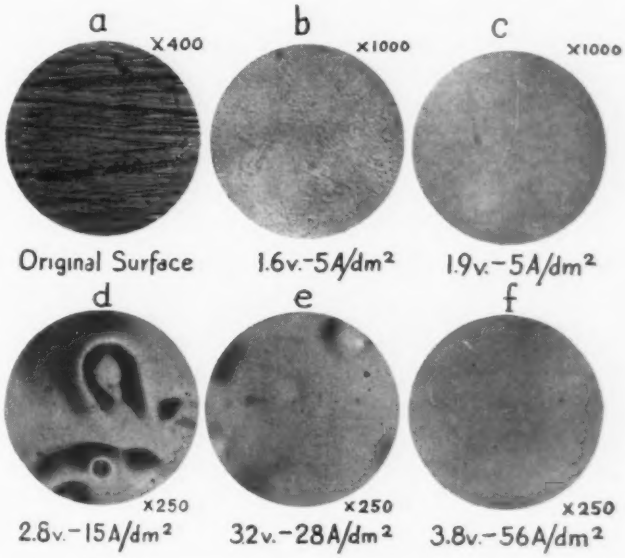


Figure 2B—Micrographic appearance of copper surface treated under conditions shown in Figure 2A. All samples polished for 30 minutes.

a—Original surface.
b—1.6 v. @ 5 A/dm².
c—1.9 v. @ 5 A/dm².
d—2.8 v. @ 15 A/dm².
e—3.2 v. @ 28 A/dm².
f—3.8 v. @ 56 A/dm².

rapidly, without the necessity of altering the setting of the rheostat, the voltage increases and simultaneously the current density decreases to 6 A/dm² (56 A/ft²). The region near the point B is a zone of instability, the exact position of which depends to a large extent upon the speed with which the AB branch has been traced. Starting with point C both current density and potential are stable and in order to continue to trace the curve it is necessary to reduce a portion of the resistance CB in series with the cell. Under these conditions there is observed a plateau of current density CD, where the voltage increases and the cur-

* *These regions are not well defined as the anodic surface area is not more than a few square centimeters. On the contrary, the measurement of the potential, not at the terminals but at the anode, gives a curve which is independent of the surface of the anode. (A. A. Hughan and R. W. K. Honeycombe, J. Council Scient.—Vol. 20, 1947, p. 297.)*

rent density maintains its value I_1. The CD region is generally between 1.45 and 2.2 volts. Beginning with D the current density increases regularly and rapidly along DE, and at this point anodic solution is accompanied by a more and more vigorous evolution of gas.

The curve I=f(V) thus being defined, we should ask the two following questions:

1. What is the appearance of the surface of the copper in the different regions of the curve, assuming that one maintains stable conditions of electrolysis for a sufficient time at each point?
2. Can one show, in the portion of the electrolyte near the anode, the changes in its chemical composition or physical properties which will allow interpretation of the course of the curve and the physical appearance of the surface of the metal in each region?

Let us examine what happens when the surface of a piece of copper, strongly marked by scratches from emery paper (a, Figure 2B), is left 20 to 30 minutes under the defined conditions of current. The conditions corresponding to the branch BC are evidently not able to be explored and the same holds true for the portion of AB in the vicinity of B.

a) Along the branch AB the surface retains the scratches and presents an etched, matte appearance, such as is observed with copper anodes in electroplating.

b) On the branch CD the scratches disappear little by little and the surface takes on a polished appearance. The brightness is, however, only observed if the potential at the terminals is in the vicinity of the value V_2 marking the right extremity of the branch (c, Figure 2B). Under slightly lower voltage the structure of copper is visible (b, Figure 2B).

c) Finally, let us consider the branch DE, first in a region not too far from D, such that the current density is equal to or double I_1. The scratches disappear, the surface becomes brilliant, but it shows small craters (d, Figure 2B), the existence of which should be related to the evolution of gases; this is in fact quite distinct, but not very abundant (the efficiency of the solution of the copper, which has been 100% for the current on the plateau, is now at 80 to 85%). The pitting or "craters" are due to the more rapid attack of the metal around each little bubble adhering to the surface. If we consider next the area much further from D, such that the current density is a minimum of 50 A/dm² (465 A/ft²) the efficiency of solution is only 28% and the evolution of gas is so vigorous that the bubbles do not adhere and thus the craters do not appear (f, Figure 2B). At intermediate current densities, the craters are more pronounced (e, Figure 2B).

In conclusion, the polishing effect starts at the potential drop BC and continues through the mounting current and voltage shown the length of DE, but the best quality of the polish is obtained at the end of the CD plateau, or that is to say either at low or very high current densities. In the first region the phenomenon can be controlled by a measure of the potential at the terminals, for the current practically does not vary up to the point D where gas formation suddenly appears, and causes craters. On the other hand the minimum value of the current density controls the second region.

Phenomena Observed Around the Anode During Electrolysis

This concerns qualitative observations which were made by tangential examination, under an enlargement of 50 to 100 diameters, of the horizontal anodic surface. If the metal remains sufficiently long under the conditions corresponding to the branch AB of the curve, one sees a solid brown film appear, which adheres well to the surface but which is detached when the current density approaches point B. The layer of electrolyte in the vicinity of the anodic surface takes on a blue tint which contrasts distinctly with the rest of the bath, but the thickness of the layer, on the contrary, remains very thin starting at the point C or at the moment when the voltage shows a rapid increase. Its thickness, which is about 0.05 mm. remains constant all along CD, but is reduced to 0.035 mm. by moderate agitation of the liquid and to 0.025 mm. if the agitation is vigorous. Parallel to this, the potential at the terminals decreases from 1.8 volts to 1.3 volts in the first case and to 1.2 volts in the second, and a surface originally well polished, left long enough under these conditions, takes on an etched appearance such as that caused by treatment with dilute nitric acid.

These experiments prove, for one thing, a strict relationship between polarization and the liquid layer composed of the products of solution of the copper: also a relationship, no less strict, between this liquid layer and the effect of polishing. This is why we have tried from the start of our research to explain the mechanism of polishing as a function of the anodic layer, rich in products of solution and very viscous.

It is possible to state more precisely the role of this anodic layer. As an illustration let us take a surface of copper which has been scratched deeply and observe the section under a magnification of 100 diameters, and in the course of electrolysis. The colored liquid film is oriented parallel to the contour of the surface, or in other words it is spread over the geometric irregularities in such a manner that it is thicker in the valleys than on the ridges. See Figure 3. This layer apparently forms a dielectric screen, since its appearance and development coincide with the increase in potential at the terminals. One might conclude that the resistance to the passage of the current would be greater in the valleys and there the current density would be a minimum, or on the other hand, that the ridges would receive the maximum current and thus dissolve more rapidly with the resulting leveling of the surface.

A slightly different explanation was presented by *Elmore*[9]. According to this physicist, the viscous liquid film is a factor in the polishing effect but its insulating properties were not responsible: the rapidity of solution would depend upon the respective gra-

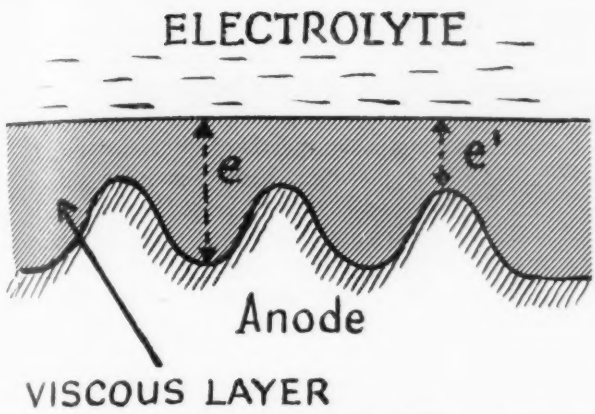


Figure 3. Illustrating the viscous diffusion layer formed at the surface of a part during electropolishing.

dients of concentration which exist in the valleys or on the ridges, very slow in the former and very high in the latter, thus the removal of the ridges.

The English physical chemist *U. R. Evans* explains the phenomenon of electrolytic polishing more simply as a nearly complete passivation of the valleys, leaving the elevations active with the result that they dissolve under the effect of the current. The co-existence of adjacent passive and active zones is only conceivable if they are immersed in a very slightly conducting medium.[10] This explanation, however, also admits that the viscous and dielectric liquid layer plays a fundamental role.

The two hypotheses presented above explain quite well polishing on a microscopic scale, or progressive elimination of irregularities as long as the differences of level are relatively large, i.e., between 0.1 and 0.001 mm. (.004"—, 00004"), but they are insufficient when the scale becomes submicroscopic. It is quite certain that the degree of polishing reaches this stage, as it is shown by the phenomenon of brightening which precedes the macroscopic polishing, and which corresponds to the rapid disappearance of the very small irregularities situated in the bottoms of the valleys and on the slopes of the ridges. It is true that the passivation theory of Evans can account for the submicroscopic polishing. The passivating effect in the regions where the diffusion of the products of attack is the most difficult may result either in the partial crystallization of the materials resulting in a solid film according to the theory of *W. J. Muller*, or in the formation of an oxide film (*U. R. Evans, Hedges, etc.*), or even in the physical adsorption of atoms or molecules of oxygen. Let us now examine the three theories and determine which gives the best accounting for the experimental data.

Formation of Solid Products

The viscous diffusion layer contains one or more products of anodic solution which consequently are quite soluble, but which, however, are not infinitely so. It is easy to show that the crystallization of a solid salt in the course of polishing cannot occur, since it is prevented by diffusion or simple flow of the viscous film. For example, returning to the case of polishing copper in orthophosphoric acid, if the anode is placed in a small non-conducting reservoir below the cathode and under a potential of 1.7 to 1.8 volts such as corresponds to polishing conditions, more or less continuous solid crust can be seen gradually forming over *all* of the surface. The metal under this crust appears bright but very rough, for solution of the metal is not uniform and it takes place more rapidly at the discontinuities of the solid film. One may also admit that this phenomenon appears under normal polishing conditions, but only at the base of the ridges and at the bottom of the valleys where the concentration of the salts is the highest because diffusion is most difficult, thus protecting these areas. We should specify further that in the preceding experiment the formation of a solid crust is accompanied by gas evolution, even though the potential applied does not reach the critical value of 2.1 to 2.2 volts for the formation of fine gas bubbles when the anode is freely suspended in a large volume of electrolyte. This observation leads us to the two other theories introducing gaseous oxygen.

2. Formation of a Film of Oxide of an Adsorbed Film of Oxygen.

The polarization from concentration is shown by an increase in the potential at the terminals, or in other words, by an increase in anode potential, since the resistance of the mass of the electrolyte and the potential at the cathode do not change. It is possible that all of the points of the anode are not at the same potential. The liquid layer in contact with the slopes and the bottoms of the valleys are most quickly saturated with the products of solution, thus the potential of the metal in these areas is higher than on the ridges where the diffusion is at a maximum. Therefore the necessary potential for the electrolytic liberation of oxygen atoms is reached first at these points, and before the gas exists in sufficient quantity to give rise to visible bubbles one may assume that either an extremely thin film of oxide is formed, or that a layer of molecules is bound by adsorption, both playing the role of an electrical insulator and giving the regions which they cover a noticeable passivation.

Do the experimental facts allow us to verify these hypotheses? We will give a few typical examples.

a) Formation of Solid at the Bottom of the Scratches.

With copper in a medium of phosphoric acid, the abrupt break in the current (point B of the curve in Figure 2A) is often preceded by the appearance of a thin, solid brown film, the composition and origin of which is not yet known, if the surface of the metal is particularly rough. We thought in the beginning that it was a question of the normal film of oxide which covers metals exposed to air (films isolated by U. R. Evans and his students), but its formation seemed to be covered principally by the micro-profile of the surface. Thus we conclude that it might result, at least partially, from the crystallization of the decomposition products in the deepest valleys.

The same phenomenon appears with steel at the start of its polishing in an acetic-perchloric acid

bath, and its further study actually shows the fundamental influence of this layer on the shape of the curve I=f(V).

b) Formation of Solid Oxide or of Adsorbed Gaseous Oxygen.

For the basis of this hypothesis one may cite the fact that the maximum polishing of copper is always obtained when the potential at the terminals is very near that causing a visible evolution of oxygen, and starting at this point, with the exception of the formation of craters, the polishing effect is observed for all values of the current density. In the case of the "Alzak" and "Brytal" processes for brightening aluminum, one may show that the brightening effect[11] (and even the polishing if the electrolysis is carried out for a sufficiently long time), is governed by the formation of a very thin film of alumina which is continuous from the bottom of the valleys to the peaks. It is also known that certain polishing electrolytes contain oxidizing chemical compounds (chromic acid for example). Finally, it is necessary to emphasize the remarkable fact that the electrolytic polishing of iron and steel in baths composed of perchloric acid and acetic anhydride is never accompanied by a visible evolution of gas at the anode, even at the highest potentials and current densities, 40-50 volts, 15 to 30 A/dm^2 (375—465 A/ft^2) which shows an overvoltage quite abnormal for oxygen.

Chemical Aspect of Electrolytic Polishing

Until now we have considered only the physical aspects of the phenomenon of polishing and now we shall discuss its chemistry. Unfortunately the experimental investigation of this phase is still not very far advanced.

When the polishing is accompanied by the formation of a liquid film, this film contains a high concentration of one or more of the solution products of the metal. The film is certainly not homogeneous. Besides the tremendous gradient of concentration from the peaks to the valleys, the base of the film or the part in contact with the metal is probably of a different composition than those portions situated nearest the electrolyte. We have seen that one may assume the presence of oxides or solid salts whose existence is perhaps ephemeral since under equilibrium conditions these products may alternately form and dissolve.

When considering the nature of the salts which arise at the anode, and in solution form the viscous layer, one has good reason to believe that these are complex salts. From the start it is remarkable that the polishing baths are composed of chemical compounds known for their readiness to form complex salts with metals: phosphoric, acetic and perchloric acids and alkali cyanides. In the particular case of the polishing of copper and cadmium in a phosphoric acid media, *M. Mercadie* was able to demonstrate experimentally that the metal is not found dissolved in the viscous layer in the form of free cations but has formed an electrostatically neutral complex with the phosphate anion.[12] This result is very interesting since it explains very nicely the origin of the increased resistance associated with the liquid film.

The existence of complex salts also explains a number of apparently abnormal facts. For example, in a perchloric-acetic polishing bath, aluminum dissolves 2.5 times more readily than is indicated by Faraday's law, or the rate of solution corresponds to the unheard of valence of 1.25 for aluminum. On the other hand, in a phosphoric-chromic polishing medium, iron dissolves according to the valance of 5!

Conclusions on the Possible Mechanisms of Electrolytic Polishing

Electrolytic polishing is only possible in a medium in which the anodic products of solution of the metal under consideration possess an extremely high solubility. The mechanism of the polishing process is probably not unique, and exhibits several variables such as the nature of the metal, the composition of the bath and the conditions of electrolysis. The polarization of concentration is a fundamental factor but its origin and its secondary effects might vary. Furthermore, the initial condition of the surface of the metal subjected to electrolysis should play an appreciable role. Finally, it is expedient to distinguish between the phenomena of macro and micro polishing. If the former is explained well enough by the presence of a thick viscous layer of the products of attack, then the micropolishing would result from the formation of a permanent or transitory oxide of the metal or of a film of physically adsorbed gaseous oxygen.

The nature and structure of the film covering the anode during polishing differs greatly according to the electrolyte used. The only point in common to the liquid, solid, or mixed (liquid-solid, solid-gas, etc.) films, is their effect of essentially passivating the valleys and concentration of the process of solution on the ridges.

For a single metal, all of the polishing baths actually known are not equivalent in their effects. Some are capable of eliminating quite large irregularities rapidly even though operating at a very low current density. Others are very efficient for the removal of micro imperfections still leaving the larger defects (they give good micropolishing). These are more brightening than polishing baths. Finally there are numerous intermediate cases between the two extremes. These different stages are explained by the nature, the thickness, and the physico-chemical properties of the different types of anodic films.

Because of numerous studies it is again necessary to review the fundamental mechanisms of electropolishing. These studies are evidently in close liason with the general knowledge of anodic processes (passivation, oxygen overvoltage, etc.), which have been neglected by the electrochemists to the present in order to profit by the cathodic processes. It would be desirable that the research for the possible perfection of polishing should serve the purpose of giving a better understanding of the reactions at the site of the anode.

(Part II and references will appear in June issue)

(All photos courtesy of Bendix Aviation Corp.)

Submerged Abrasive Burnishing—Part I

By Joseph E. Wingate, *Barrel Methods Engineer, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.*

In this first article on submerged burnishing the author reviews the application and principles of this versatile barrel process. Types of media and soaps are also covered. Future articles will give detailed recommendations for parts handling, stone curing, selection of media sizes, work-load ratios, barrel speeds, etc.—ED.

Introduction

NATURE was kind when it proved from a physical standpoint that the combined action of various minerals in the form of rocks and water could erode to the point of extinction any matter on earth. Man was alert when he recognized that by harnessing and controlling these phenomena a powerful weapon could be beneficially applied to his problems. Every theory and practice applied to modern day barrel processing can be directly traced to the action of rocks and pebbles gently washing down the bed of a placid mountain stream, or masses of boulders crashing through the Grand Canyon as in by-gone days.

Many papers have been presented to prospective users of burnishing and barreling processes stressing the economic virtues offered by this or allied processes. Many varied from fantastic to ridiculous, while others presented such nominal savings in relation to installation costs that administrative officials merely smiled and went on to other exploits that offered a greater ratio of savings to installation costs.

It is the intention of this paper to present an example of how effective and efficient a minor installation can be. The facts and information offered here may be accepted only partially by those unfamiliar with results obtained through this versatile process, but let it be stated clearly that the material presented herein is the direct result of this writer's working experiences, and not just a fancy theory.

Polish Defined

As the entire theme of this article is built around the economics and superior results obtained in barrel polishing and deburring using submerged abrasive burnishing techniques, it is felt that a brief discussion of the term "polishing" should be offered.

The word "polish" as seen on many of today's blueprints is not worthy of the ink it is written with, and how smooth is smooth can create quite a furor. To be of any value, smoothness or polish must be defined in a manner capable of eliminating various personal opinions. Surface analyzers answer this purpose very well.

The term should also be defined by the degree of reflectivity of the surface. *Polish* and *smooth* are not genuinely synonymous words. A surface can be smooth to one micro-inch without being glossy. Inversely, a piece of warped glass can have a highly polished surface and not be smooth.

Surface finishes arrived at by burnishing in stone, when compared to wheel jobs or ball burnishing jobs, must not be judged by a visual inspection method, but compared by readings of a profilometer. An excellent example of fallacious comparisons can be made by abrasive burnishing a rough-ground pin that has been nickelplated, and burnishing a finish-ground cadmium plated pin. At the end of the cycle the nickel pin has

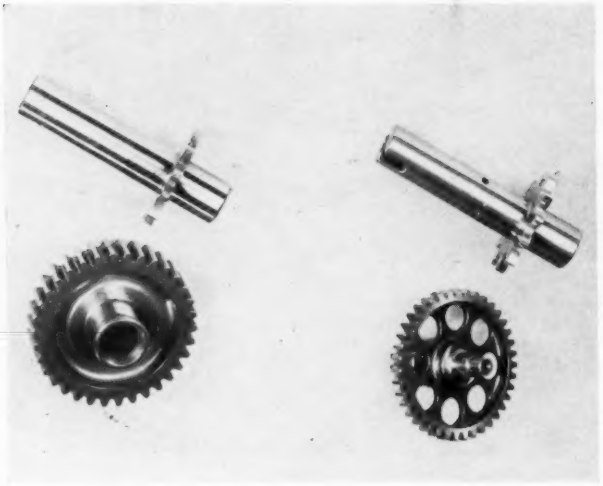


Figure 1. A typical example of the possibilities of submerged abrasive burnishing is the improvement in surface finish of these precision gears from an original micro-inch finish of 13 to a final 3 micro-inches rms. At the same time all the edges are evenly burred and radiused.

a higher reflective surface. The cadmium pin, although having a frosted appearance, is smoother by six (6) micro-inches. This emphasizes that surfaces should be measured rather than visually compared.

With very few exceptions, today's abrasive burnishing processes are outstripping in economy and results obtained with the older types of barreling processes built around metal tumbling media. The older processes involved the use of slugs, jacks and balls of various sizes and materials. Supplementing this diversified group of ferrous and non-ferrous metals was a host of fancy earths, compounds, and baffling acid and alkaline powders. Experience has indicated that one reason for barrel processing being dormant for a long period of time could be traced to indifference or lack of know-how on the part of many management representatives, and their failure to investigate the many avenues of accomplishment associated with the modern trends in barreling.

Today manufacturers of abrasive products are furthering research in synthetic media and barrel processes to the tune of many thousands of dollars yearly. It is useless to deny progress in this field when such earnest effort is directed toward bettering and simplifying both results and operational costs.

To aid and abet this move toward higher quality and lower cost, a number of forward-thinking managements are assigning personnel to the exclusive task of pursuing and developing barrel data that is to be used solely for quality control and cost reduction purposes. This intelligent approach has led to many versatile and worthwhile procedures, many of which are a radical improvement over hand and antiquated barrel processes. One of these is the process known as submerged abrasive burnishing.

Submerged Abrasive Burnishing

Submerged abrasive burnishing is exactly what the name implies. Every part of the processing drum and its load is submerged in a lather of neutral soap and water.

Many versatile operations can be performed by this process, namely; deburring, super-finishing, and imparting an eye-appealing lustre to metal work of many types. Figures 1, 2, 3, 4 indicate the wide range of parts that have been successfully burnished in the author's plant. Many of these parts would ordinarily not be considered suitable for barrel methods due to their fragile nature or the extremely close dimensional control required of them.

Of special interest is the ability of the larger size stones in this process to remove heat treat scale, to strip parts of paints and lacquers, and to remove rust, within certain limitations. A notable accomplishment in the author's plant was the removal from copper parts of varnish covered with an additional insulating layer of linen impregnated with more varnish. This tenacious covering was removed and sharp ends of the copper bars deburred. Unsatisfactory plating of all types may be safely removed, the surfaces honed and usually left in such a clean, smooth condition when removed from the drum that further pre-plating treatment is unnecessary.

Of all the deburring and burnishing equipment now marketed, the submerged type barrel has no peer, in this writer's opinion. While a statement of this nature will no doubt create considerable controversy in the various fields allied to burnishing, further investigation of this article will bear this statement out.

Submerged burnishing deviates radically from the usual ball furnishing process in that the time cycle required for a particular application is reduced in most cases by at least 50%. It seems prudent to make a comparison of the two methods in order to properly define the advantages found in using the submerged burnishing process.

In its true sense, ball burnishing is a tumbling process devised to impart a superficial polish to various metals. This polish is attained by the action of the balls contacting and peening over surface irregularities. Another function of the ball is the rolling over or breaking off of any burrs on corners or edges. Ball burnishing was not devised to *remove* pits or scratches, but to push sufficient metal into the existing flaws to make parts seem smooth to the eye. Almost

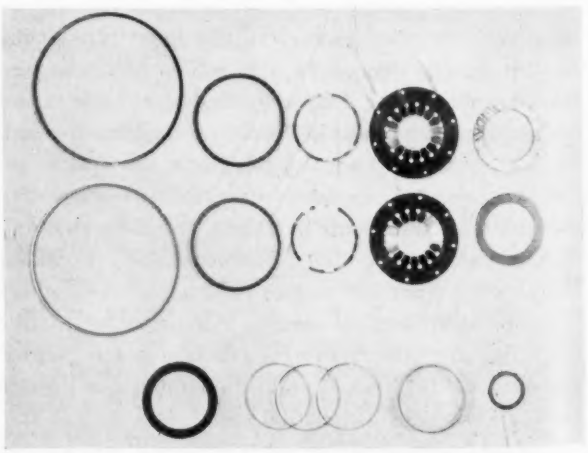


Figure 2. Extremely fragile parts, not usually considered suitable for barrel treatment, are successfully treated by this process. The thinnest rings at the bottom center are 1½" in dia. and .004" thick.

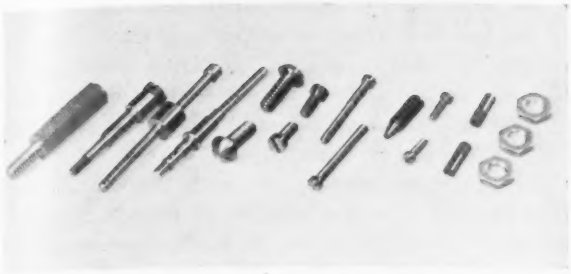


Figure 3. **Threaded parts are commonly burnished in submerged barrels to remove burrs and improve surface finish without damaging the threads, which are Class 2 and finer in tolerances.**

no metal is removed in a true ball burnishing process. In most cases, the surfaces of ball burnished parts are apparently brightened. However, as measured by a profilometer, the surfaces often show an actual deterioration, or an increase in surface roughness. Instances involving the ball burnishing of parts having a hardness comparable to the hardness of the ball itself indicate that the surface change in appearance and measured finish is usually negligible. This applies especially to steel parts having surface stains.

Fabricators of painted or plated parts are familiar with parts that acquire an unaccountable bloom or finish spoilage during use of the part. This condition has been traced in many cases to soils being pounded into the pores of the metal. Foreign matters may be sealed in, due to the peening action in the ball burnishing process. A year or so later, these dirts have a tendency to change their position and the finish then blossoms out, much to the dismay of the manufacturer or user.

Let us now consider abrasive burnishing. This process definitely does not peen over or mash down surface irregularities. Instead, it gently polish abrades the entire piece. During this process, a controlled amount of stock is removed, if the parts are properly handled. The amount of stock removed is dependent on the surface finish prior to barreling, as well as several other factors to be discussed later. The amount of stock displaced (peening in the case of ball burnishing and removal in the case of abrasive burnishing) is in the majority of instances less when a submerged burnishing process is used, and many variations of the original submerged barrel are in daily use.

Abrasive Burnishing Action

A unique, but effective action that occurs in submerged burnishing, is well worth reviewing to users of this equipment and divulging to those unfamiliar with this process. Refer to Figure 6.

The shape of the barrel is hexagonal, therefore a greater amount of controlled "heaving" and rolling of the mass takes place than would result if the drum were nearer round, or octagonal. This heaving and rolling is due to the motion of the barrel riding the mass of stone up to the approximate horizontal point of the barrel, then gently heaving it toward the opposite side.

As the particular flat or section of the drum on which a given amount of mass is being carried starts the upper half of the cycle, the mass reaches the zenith of its flight and tends to fan out and create a screen of stone over the entire upper section of the barrel. In a properly loaded and speed-regulated barrel this screen of stone is supplemented by a complete atmosphere of heavy lather and the parts being processed. This is one of the factors that account for the high polish and burnish imparted to the parts. The turbulence created in the mass causes the media to pass through slots, holes, and openings in the parts being processed.

Due to a differential in the density of the parts being processed and the media being used, the part assumes a speed approximately two thirds to one-half that of the media. Through this action, the abrasive media is caused to contact the part on all surfaces, creating a honing action. The honing is attributed to the following facts: A smooth surface offers considerably less resistance to another member being impelled or forced across its surface than would a rough surface. It is self-evident that pressure exerted by the stone to a rough surface is far greater than the pressure applied to a like part with a smooth surface. This is the action required to deburr and improve surface finish of parts at the same time.

To illustrate these principles, let us examine the submerged burnishing of a bronze bearing plate, Figure 7. Part A shows the plate as it comes directly from the punching operation. A burr left by this press operation measures .003", while a profilometer reading across the surface measures 11 micro-inches R.M.S.

B shows the piece after barreling for one (1) hour. This piece has required a criss-cross surface appearance due to the media honing off the peaks of the surface irregularities. The burr on the edge now measures .001" and the surface finish 9 micro-inches.

C indicates further honing at the end of a two hour cycle. All burrs are completely removed, the part developing a polish. The plane surfaces of the piece now measure five micro-inches.

D shows a greater degree of polish, a radius of the outer corners measuring .005" and a surface smooth-

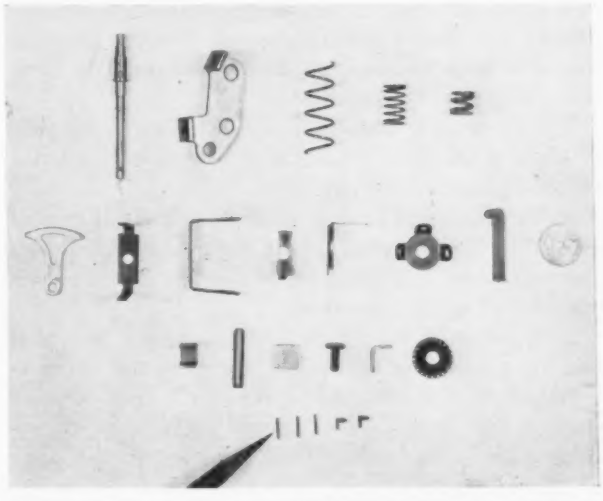


Figure 4. **Another group of delicate parts handled successfully in the author's plant. Compare their size with the pencil tip at the lower left.**

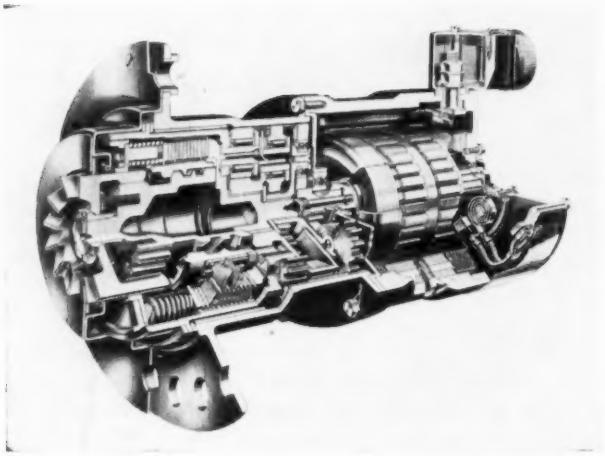


Figure 5. Some idea of the intricacy and accuracy required in the parts treated in the Bendix Co. operations may be obtained from this cutaway view of one of their aircraft engine starters. Over 50 of the components of this unit are barrel burnished.

ness measuring four micro-inches after three (3) hours processing.

E shows a completed piece. The time cycle is four (4) hours. The finished surface now measures three micro-inches, and the edges and corners are completely deburred. A radius of .010" has been created on these corners, and all surfaces have been burnished to a high luster. This is the desired result.

The foregoing is intended to illustrate the degree of improvement per hour of processing time. It also conveys these salient points:

1. All burrs have been removed, edges broken, and finish has been improved.
2. Further barreling would increase the radii too rapidly, improving the micro-inch reading only slightly per hour of processing.
3. Every revolution made by the drum imparts a finer degree of finish to the surface and as rapidly as the surface improves the pressure exerted on these parts decreases. Due to this pressure decrease, the honing action is lessened accordingly.

When any surface being processed reaches a micro-inch finish of two or under, the pressure exerted to the part by the media is so decreased that the time required to improve these surfaces would result in over-processing the edges and radii.

The advantages derived from having a greater ratio of water to media and parts than occurs in ball burnishing, should also be explained.

As the total cubic volume of the barrels is not greater than 25% of the volume of the outer tank, it indicates that many excellent functions can be attributed to this reservoir of working solution.

It is generally agreed by ball burnishing men that soils or greases should not be present in the barrel if a high quality finish is to be expected. The lather or suds created in the barrel should be capable of preventing this alien matter from adhering to the parts or burnishing media.

A natural result is that, in ordinary burnishing, the amount of foreign matter that can be accommodated by the sudsy part, or the solution itself and still permit the barrel to function properly, is limited by the quantity of suds available. Differing considerably from this limited suds condition is the abundant medium of suspension or dispersal offered by the lather in the submerged type barrel.

During the processing cycle, many fine particles of oil, scale and a certain amount of foreign matter is burnished off of the parts. A limited percentage of the media is also eroded. As these small particles become detached, they float free and are enveloped in the solution. Being small and light, they are forced to the outer fringes of the mass. As this matter reaches the sides of the drum, an exit is offered by the perforated side plates. Centrifugal action created in the drum forces these unwanted materials out through the ports, leaving the remaining suds and solution clean and free to repeat this process. On the upward sweep of the revolution made by the drum, a new fresh solution is drawn inside to replace that part emitted. As to what happens to the undesirable material that has been ejected through the ports, it is either suspended in the suds, remains in an emulsified form, or settles to the bottom of the tank in the form of residue.

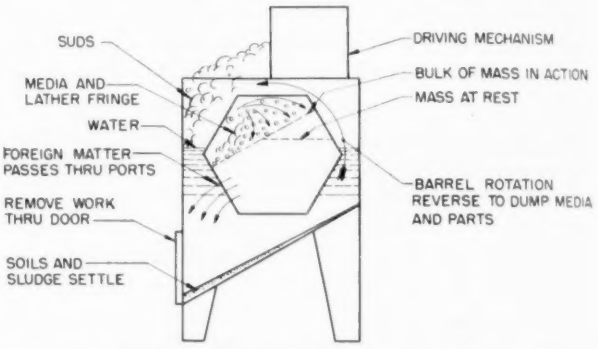


Figure 6. Sketch illustrating submerged abrasive burnishing action.

Further proof of the scrupulously clean condition created by these factors can be found by examining the internal walls of the drum and the media itself. No trace of grit or grease will be found on the highly burnished sides of the drum, nor on the media.

Surface Improvement

In order to illustrate the possibilities of the submerged burnishing barrel, a chart of surface improvement vs. running time is presented in Table I. As deburring of corners and edges is automatically executed during the cycle, this item is not recorded. Dimensional change has been considered as a factor in this presentation, and as losses of only .00005" are encountered, it is felt that amounts under and up to this figure are negligible.

Figure 7. See text for description. Part "a" on left; part "e" on right.

TABLE I—Surface Improvement

Material	Rockwell Hardness	Dia.	Initial Micro-In.	Micro-Inches after 2 Hrs.	4 Hrs.	6 Hrs.	8 Hrs.	10 Hrs.
Steel			32	10	8	7	5.5	4
E-4350-1	C42/46	2.207″	25	8	6	4	3	2.25
			12	6	4.5	3.5	2	1.5
			8	5	3.5	2	1.5	1.2
Steel			30	15	8	6	4	3
52100	C44/48	.375″	20	11	7	5	4	3
			10	7	6	4.5	3.25	2
Steel								
52100	C64/68	2.250″	25	14	6.5	4.5	3.75	3.20
Bronze			35	12	8	6	4.5	3
No. 68		.760″	20	8	5	3.5	3	2.5
			12	5	3.5	2.5	1.67	1.3
Steel			20	12	8	7	6	5
2330	C39/45	.125″	12	8	6.67	5.67	4.67	3
			8	5	4	3.67	2.67	2

While discussing errors as slight as .00005″ this writer's opinion is that variations as little as this can in many cases be attributed to temperature changes, normal errors in measuring apparatus, or, if manually measured, variation in the feel or touch of the individual making the measurement.

All charted results were obtained from parts that were ground on standard machinery using standard grit wheels. For non-ferrous parts held to comparable micro-inch finishes of ferrous parts prior to barreling, the rate of surface improvement during barreling is approximately 60% faster for the non-ferrous parts, as can be noted on the chart. Barrel cycles exceeding 10 hours are not considered, as cycles of this duration usually create too large a radii on parts that are in the low micro-inch class. For castings, however, these large radii are usually of no consequence.

The lowest micro-inch finish brought about by this series of experiments is 1.2 micro-inches. Requirements below this figure have not been needed in our plant for other than special applications. Very few parts in production today in general manufacture require finishes of under 2 micro-inches.

The data in Table I was obtained by using symmetrical parts as specimens. The irregularities offered by non-symmetrical parts prohibits the presentation of a chart or table for general use. There is however, a general guide to be followed. Any parts having both protuberances and concave areas can be satisfactorily deburred and burnished, providing the acute or sunken portion of the area does not exceed the convex or protruding area by more than 40%. If dimensional changes of .0001″ to .0002″ are permissible and time scheduling allows, micro-inch finishes of one and under have been obtained by allowing parts to burnish up to fourteen hours.

Equipment Required

First hand we will describe our small installation. In its entirety it consists of two submerged type burnishing barrels, each having two drums or pockets. A vapor degreaser is used for pre-tumbling cleaning. To maintain properly sized media, a portable stone grader is included. To facilitate handling and storage of burnishing media, at least five gravity type stone bins are needed. To supplement the washing of parts, a hot water rinsing tank common to existing facilities is included. For post-tumbling operations a slushing tank containing a reliable grade of water dispelling and rust inhibiting protective oil is recommended. This equipment should be arranged in a neat and simple manner, and the immediate work area should also contain a small work bench.

Barrels

The barrel as illustrated in Figure 8 consists of dual steel drums on a common horizontal axle. Drums used in this process are hexagonal in shape, 15″ in diameter, and have a door opening approximately 90% of the total area of one side. These drums are mounted on three bearing blocks, one block at each end of the tank and a third block located between the two drums and common to both. The three bearings are the only support for the drums. End bearings are positioned in such a manner as to allow the apex of the angle of the flats to extend within two inches of the upper edge of the tank. Both drums are variable-speed chain driven. A minimum of 35 and a maximum of 70 R.P.M. serves to cover any speed requirements necessary in this process. Each drum contains two perforated sheet metal windows on each of three of the six sides of the drum, a total of six windows per drum, and cover one-quarter of the area

of one flat. Windows or water parts, as they may be called, are constructed of 3/64" sheet brass, each containing 1/16" diameter holes, equi-spaced to 1/8" apart to cover the entire window surface.

Metal used in the construction of the drums and outer tank is No. 10 gage (.140") sheet iron. Doors are made of metal slightly heavier. The tumbling pockets proper are double welded to eliminate projections or cracks in which thin or fragile parts might lodge.

The outer tank which contains the burnishing liquids is rectangular and is also constructed of No. 10 gage sheet metal. Outer tanks of submerged burnishing equipment usually contain four times the cubic capacity of the inner drums. Inner drums are mounted so as to allow sufficient clearance on each end and in the space between the drums to allow cleaning of the apparatus, as the area between the two drums is the point from which the mechanism is driven. A screen guard should completely cover this space as a safety measure.

A standard type drain-cock is incorporated in the bottom of the outer tank. This expedites changing solutions and rinsing down the equipment. Water connections are made to accommodate the filling of the tank. A single steam coil serves to bring the solution up to a temperature of approximately 120°F., which is about the most efficient point at which to operate. Under these warm conditions the soap lathering is more rapid, and removing the chill from the water makes for pleasanter working conditions for the operator.

Care should be used to avoid overheating the solution. Parts treated in too hot a solution will undergo too rapid drying. This makes suds removal bothersome.

A perforated metal screen mounted in the outer tank at an angle of 30° serves as an excellent gravity chute for the removal of parts and media from the barrel. A water tight door at the lower extremity of this chute serves as the exit for the work and stones, after the burnishing fluid mass has been drained off. This door is controlled by threaded dogs and single wing nuts and is easily maneuvered.

Abrasive Stone

The most desirable type of stone found to this date for submerged abrasive burnishing is a manufactured form of aluminum oxide. Burnishing and deburring stone made from this material has been in use for the last ten years.

Many comprehensive tests were undertaken by this writer to find a better or comparable medium for barrel work. Included in these test runs were three types of limestone, several varieties of marble, and granite. None of those, however, were versatile enough to measure up to the manufactured material.

Aluminum oxide stones are obtained by processing a mineral named Bauxite, the basic material from which aluminum is obtained. In appearance, Bauxite resembles a yellowish clay. To the touch this ore is soft and earthy.

The formation of the stone proper is the result of electric furnace fusion of silicon carbide and aluminum oxide. At the conclusion of the fusing process, the resulting mass is poured into small pre-forms or slag sheets. After cooling, the briquettes or sheets are crushed and screened or grading purposes. For rough tumbling purposes, this is sufficient processing, but for burnishing work, further operations are required. A tumbling process to remove all sharp corners and slivers is added to insure a blocky type material. After this smoothing process, the material is called "tumbled abrasive."

In appearance this stone resembles pieces of smooth, soft coal. See Figure 9. A breakdown shows the stone to be composed of 300 to 600 mesh particles of silicon carbide embedded in a mass of aluminum oxide. The stone registers an average of 8.5 on the Mohs hardness scale. A comprehensive test to determine the depreciation rate per hour, for cost purposes, and to determine the action of the stone under typical working conditions was made, as follows:

Barrel—Unlined steel hexagon shell, 15" dia. x 24" long

Barrel Speed—45 R.P.M.

Media Used—200 lbs. No. 3 Stones (1/2")

Parts Used—1" Square steel blocks C30/36 Rockwell hardness

Wt. of Parts—92 lbs.

Barrel Cycle—24 hours

The results obtained showed:

Stone Depreciation due to surface erosion—3%

Stone Depreciation due to breakage—25%

Effect of action on flat surfaces of parts—50 micro-inches R.M.S. at start of Cycle—6-Micro-inches at end of run. All surfaces dull prior to barreling, bright and lustrous in appearance at end of run.

Rounding effect on radii test parts—.024"-.028"

Waste water—milky gray precipitate.

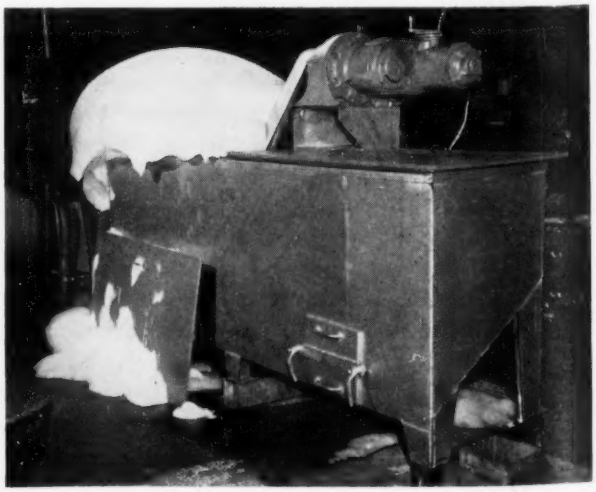


Figure 8. Submerged barrel in the author's plant. Note the heavy "head" of suds, indicative of proper soap conditions in the burnishing mass.

Figure 9. **Abrasive for submerged burnishing is smooth and nearly round.**

New stone was used for the test. Previously used stone will show less depreciation. Likewise, small stone will show less wear per twenty-four hour run. Overall performance and wearing qualities indicate this abrasive has yet to find an equal. During use, the surface erosion is slow and even. The composition is such that the stone tends to wear into a desirable blocky type. The near round or symmertical shape this stone maintains is significant, as it eliminates unnecessary handling during the grading of the stone into usable sizes, and reduces the likelihood of slivers becoming detached from the main body of the stone, thereby decreasing the stone depreciation and eliminating the danger of the broken or sharp edges becoming lodged in crevasses or holes in the parts.

From an economic standpoint, experience shows that the cost per piece for processing parts with this material is extremely low. An actual case record shows over 2,055,000 parts processed during a working year. During this time, one ton of stone was depreciated, attributable to breakage and surface erosion. It is readily seen that the cost is minute, but for those who want the exact figure, it is .012 cents per piece.

Soap And Its Action

A key factor in submerged burnishing is a good grade of soap. In order for the other component parts to do their work properly, it must have the following qualities:

1. Be as neutral as possible while retaining the power necessary to soften or dissolve mineral deposits found in a commercial water supply.

2. The soap should be readily soluble in room temperature water and capable of producing a low air-content bubble while maintaining a large head of individually small bubbles. This lather or suds is of utmost importance, as it is a controlling element of submerged burnishing.

3. A desirable compound should be able to combat fatty acids or greases carried over from previous operations and leave the parts in such a condition that rinsing in clean water will remove any residual suds or lather and leave the parts free from excessive water stains.

As previously mentioned, a controlling factor in the process is the amount of and type of suds involved. Lather, or suds, determine the lubricity of the solution which in turn is responsible for the ultimate burnish or polish.

The degree of honing on the edges and surfaces of a part can be readily controlled by varying the amount of soap used. Where a fast deburring cycle is desired and a reasonably large radius is required, a concentration of ½ the amount needed to impart burnish is used. One excellent compound for all around burnishing is used in a concentration of one ounce to the gallon of water. For a slow super-burnish, and the forming of a very minute radius on lands and edges of parts, a solution of two ounces of soap to the gallon of water can control the surface of parts to two micro-inches and the radii to .0005".

Numerous cases of inferior burnishing have been traced to the effect of the chemicals used. The use of such material is usually brought about by the attempt to change the color or artificially brighten the parts being processed, rather than by true burnishing. Some chemicals containing cyanide have been known to discolor and pit certain types of parts so badly they were unusuable.

A valuable contribution to the process may be found in investigating the condition of the lather that forms in the water tank. The condition of the burnishing mass is indicated by the buoyancy, density and color of the suds. Knowledge of how dirty stones, water or parts affect the suds is helpful in avoiding unsatisfactory results. Listed are a few factors that bear noting:

1. Physically large bubbles indicate lack of soap or improper compound for process.

2. Airy, light suds mass indicates excessive action in drum.

3. Flat, dark suds indicate dirty water, soils, or greases on the parts or media. This condition should be remedied immediately, as it results in a poor polish. An ideal lather consists of a heavy mass of 1/16" bubbles heaped over the drum at least 6". This lather will maintain its head during a six hour cycle. See Figure 8.

(To be continued)

The Analysis of Cadmium Cyanide Plating Solutions

By Louis Silverman, *Los Angeles, Cal.*

ACCURATE methods for the determination of cadmium in the presence of other metals are rather difficult. By carefully controlling the acidity of the solution, copper may be precipitated as sulfide from a solution containing copper, cadmium, zinc, nickel and iron sulfates; next, the cadmium, as sulfide, may be separated from zinc, nickel and iron sulfates.

The separation of copper from the other metals is readily performed in strongly acid solution, but the separation of cadmium from zinc is a precision routine. If a solution contains cadmium and zinc, the pH of the solution is adjusted to about pH 0.8, (about 3% in Sulfuric Acid plus some Ammonium Sulfate), heated to about 80° C., and red Cadmium Sulfide precipitated with Hydrogen Sulfide. Zinc is left in solution because the solution is too acid to permit the formation of any Zinc Sulfide. For best results, the Cadmium Sulfide is re-dissolved in acid, and re-precipitated at pH 0.8.

The acid precipitate of Cadmium Sulfide carries down considerable sulfur (as do other sulfides also), so the precipitate cannot be dried and weighed. Nor can the precipitate be titrated with Iodate, because the precipitate seems to contain Hydrogen Sulfide chemically in uncertain amounts. Therefore, the Cadmium Sulfide must either be dissolved and later electroplated, or else transferred to a platinum dish, treated with sulfuric acid and converted to Cadmium Sulfate.

Cadmium Sulfide can also be completely[1] precipitated from a Sodium Cyanide solution. Similarly, Zinc Sulfide precipitates from cyanide solution, but Copper Sulfide does not. Thus, even though a Cadmium Cyanide solution is contaminated with copper, the results are not affected by the copper.

There are two other advantages to this type of Cadmium Sulfide precipitation. Since a Cadmium Cyanide plating solution is quite alkaline, no free sulfur is formed when Sodium Sulfide is added; also, the Cadmium Sulfide does not contain excess Hydrogen Sulfide, as in the acid precipitation method.

There is one objection to alkaline sulfide methods, but this may easily be overcome. When sulfides are precipitated in alkaline solutions (such as Sodium Cyanide), the sulfides adsorb, or entrain, some of the sodium salts, (Sodium Sulfide, cyanide, chloride, etc.). Cadmium Sulfide also does this, but there is the unusual circumstance of two different Cadmium Sulfides (allotropic modifications). At room temperature Cadmium Sulfide is yellow, but in hot water (80°C.) it is red. During this change from yellow to red it is possible to wash away a large portion of the adhering salts.

In practice, Cadmium Sulfide is washed with a hot water solution containing an electrolyte such as Ammonium Chloride or sulfate. Cadmium Sulfide should not be washed with distilled water, for, after the salts are washed away, the Cadmium Sulfide will "peptize," (i.e. form a colloid) and pass through the filter paper pores into the filtrate. At this point pure Cadmium Sulfide is obtained, and the determination may be completed by titration with Potassium Ferrocyanide[2] or as outlined in the procedure below.

Ferrocyanide Titration

As to the ferrocyanide titration, there are two reasons why this procedure is not desirable, and they apply equally to cadmium and to zinc. The straight ferrocyanide titration of cadmium or zinc is empirical, and the titration requires an outside indicator. The titration is empirical since the composition of the cadmium-potassium-ferrocyanide precipitate is variable and the titer (g. per ml.) of the standard ferrocyanide is different when the titration is 8 ml., or 25 ml. or 47 ml. There are two ways in which this may be corrected: standardizing the Potassium Ferrocyanide in terms of the number of ml. used, or titrate a standard cadmium solution (approximately the same number of ml.) alongside the unknown. In a recently developed technique, excess ferrocyanide is added to the cadmium solution, and the excess ferrocyanide is back-titrated with cerate. However, this only shifts the empirical errors from the ferrocyanide to the cerate.

The objection to an outside indicator is that such a titration is more time-consuming and more tedious than a comparable titration with an inside indicator. However, there is a helping technique; just before the end point, the ferrocyanide precipitate seems to undergo a physical change, becomes more granular and tends to settle rapidly. The experienced analyst

recognizes this change and knows that he is close to the end of the titration.

An alternative plan is to add Potassium Ferricyanide to the standard ferrocyanide solution, and place some Ferrous Sulfate in the cadmium solution, as internal indicator.

An organic indicator, Diphenylamine Sulfonic Acid, has also been used in zinc titrations, as an internal indicator.

Thiosulfate-Iodate Titration

The procedure described in this paper, the Iodate—Thiosulfate titration method, is not without disadvantages. For example, the Cadmium Sulfide precipitate is easily oxidized in air, so that the washed sulfide precipitate must be covered, and used as soon as possible; the sulfide precipitate cannot be treated directly with Hydrochloric Acid, because some of the Hydrogen Sulfide thus formed may volatilize, or be decomposed into sulfur and hydrogen; and finally, the iodate titration is "indirect" since the results are obtained from the sulfide, not the cadmium, ion.

The chemical equations are:

$$Cd(CN)_2 \cdot 2NaCN + Na_2S \rightarrow CdS + 4NaCN$$
$$CdS + 2HCl \rightarrow CdCl_2 + H_2S$$

The Iodate-Iodide reaction, to give iodine:

$$KIO_3 + 5KI + 6HCl \rightarrow 6KCl + 3H_2O + 3I_2$$
$$H_2S + I_2 \rightarrow 2HI + S$$

The excess iodine is consumed:

$$I_2 + 2Na_2S_2O_3 \rightarrow Na_2S_4O_6 + 2NaI$$

In Table I, the results for fourteen operating baths and three synthetic solutions are given.

Table I

Determination of Cadmium by Iodate-Thiosulfate Titration

Bath No.	*Cd oz. per gal.*	*Bath No.*	*Cd oz. per gal.*
1	2.57, 2.60 (a)	8	1.2; 1.3 (b)
2	2.72, 2.74 (a)	9	2.3; 2.3 (b)
3	3.01, 3.02 (a)	10	2.4; 2.3 (b)
4	3.35, 3.39 (a)	11	2.7; 2.9 (b)
5	3.47, 3.49 (a)	12	3.6; 3.7 (b)
6	4.06, 4.13 (a)	13	3.7; 3.6 (b)
7	4.23, 4.36 (a)	14	3.7; 3.8 (b)
Synthetic (1 oz./gal) (c)	0.97 (d)		
Synthetic (2 oz./gal)	1.98		
Synthetic (4 oz./gal)	4.0		

(*a*) *One analyst.*

(*b*) *Two analysts.*

(*c*) *Synthetic cadmium solution. Dry anhydrous Cadmium Chloride in a 100°C oven. Weigh 12.3 g. of Cd Cl_2, transfer to a one-liter flask and dilute to the mark with water.*

(*d*) *By electrodeposition, 0.96 oz./gal.*

Procedure for the Determination of Cadmium

Pipette a 5-ml. sample into a 300-ml. beaker and add 100 ml. of water. Slowly, and with stirring, add 15 ml. of Sodium Sulfide solution to precipitate Cadmium Sulfide (yellow). Allow the precipitate to settle completely, then decant through a 15 cm. No. 7 Whatman paper containing a little paper pulp. Wash the precipitate by decantation, using hot 5% Ammonium Chloride solution, then wash the red precipitate into the filter paper. Wash the precipitate and paper 6 times with the Ammonium Chloride wash solution. Discard the filtrate.

Transfer the paper and precipitate to the original beaker, add 100 ml. of cold water and macerate the paper with a stirring rod. From a burette, add exactly 30 ml. of 0.1N Standard Iodate Solution, stir and add 2 ml. of Starch Solution. Slowly run in 50 ml. of Hydrochloric Acid (sp. g. 1.2), and stir continually. The solution should be blue, indicating excess iodine present.

(If the Cd content is greater than 4.5 oz./gal., the solution will not be blue, in which case immediately add 10 ml. more of Standard Iodate solution. However, such tests are best repeated using larger original amounts of Iodate solution.)

Back titrate with Standard Sodium Thiosulfate solution, to the disappearance of the blue color. At no time should the acid sulfide solution be permitted to become warm, as otherwise low results may be obtained.

CALCULATIONS:

Metallic Cd, oz. per gal.=1.5 (ml. KIO_3 x Normality)—(ml. $Na_2S_2O_3$ x Normality)

Cd O, oz. per gal. = 1.72 (ml. KIO_3 x Normality)—(ml. $Na_2S_2O_3$ x Normality)

Discussion on the Determination of Total Cyanide in Cadmium Solutions

There is a difference of opinion[2,3] as to the most desirable method for determining the total cyanide content. Consider the equations:

$$CdO + 2NaCN + H_2O \rightleftharpoons Cd(CN)_2 + 2NaOH \quad (1)$$
$$CD(CN)_2 + 2NaCN \rightleftharpoons Cd(CN)_2 \cdot 2NaCN \quad (2)$$
$$NaCN + AgNO_3 \rightleftharpoons AgCN + NaNO_3 \quad (3)$$

and

$$Cd(CN)_2 \cdot 2NaCN + 6NH_4OH \rightleftharpoons Cd(NH_3)_4(OH)_2 + 2NaCN + 2NH_4CN + 4H_2O \quad (4)$$

Equation (1) represents the formation of a Cadmium Cyanide plating solution from Sodium Cyanide and Cadmium Oxide. Equation (2) shows that water-insoluble Cadmium Cyanide is held in solution as a soluble "double salt" or a "complex" salt with excess Sodium Cyanide. For purposes of this paper, the soluble salt is written $Cd(CN)_2 \cdot 2NaCN$.

Equation (3) shows only that Sodium Cyanide and Silver Nitrate react to form insoluble Silver Cyanide. If *all* the cyanide in the solution can be made to react with the Silver Nitrate, the result will indicate the "total cyanide" content of the bath.

One way to convert all the cyanide to Sodium Cyanide is to eliminate the sodium-cadmium-cyanide compound. Equations (1) and (2) show that the sodium-cadmium cyanide compound exists in strongly alka-

line solution. Therefore the solution need only be made slightly acid, or neutral, and "Total Cyanide" can then be determined. As an example, a solution particularly high in cyanide content (31-32 oz./gal.) was chosen. One ml. portions were pipetted into each of two beakers containing 150 ml. of water. The pH reading was 11.0. To the first solution, 5 gm. of Boric Acid were added, and the pH fell to 6.6. To the second solution, 10 gm. of Sodium Bicarbonate were added, and the pH became 7.6. By titrating with standard Silver Nitrate it was found that the total Sodium Cyanide content for each solution was 31.5 oz./gal., which proves that, in nearly neutral solution, the correct result for total cyanide may be obtained.

Silver Iodide (Cloud Formation) End Point

Equation (1) suggests another method. The reversed arrows show that if a large amount of Sodium Hydroxide is added to the solution, the Cadmium Cyanide will revert back to Sodium Cyanide. Accordingly two beakers were prepared. The first beaker contained 150 ml. of water, one gm. of Potassium Iodide, 2 gm. of Sodium Hydroxide and 5 ml. of cyanide solution. The second beaker contained 150 ml. of water, one g. of Potassium Iodide, 6 g. of Sodium Hydroxide and 5 ml. of cyanide solution. The solutions were titrated with Silver Nitrate, to a definite cloudiness, and the results were 15.0 and 10.2 resp., oz. per gal. of Sodium Cyanide. The results, seemingly, are in reverse order. However (Equation (1)) after most of the cyanide has been titrated, only Cadmium Hydroxide is left, which starts to precipitate;* the analyst would immediately consider the precipitate to be the Silver Iodide cloud, and the apparent end point. It is necessary, then, to keep the Cadmium Hydroxide in solution, which can be accomplished by the addition of Ammonium Hydroxide[2] (equation 4), but the results by the Silver Iodide (cloud formation) method are always lower than those obtained by the Silver Chromate (color) method, which is described in the following procedure.

Silver Chromate (color) Method for Total Cyanide

There are the two very different methods by which to titrate Sodium Cyanide with Standard Silver Nitrate solution. The first one, the precipitation (cloud) method, depends on the formation of a precipitate of either Silver Iodide or Silver Cyanide, in alkaline solution:

$$2\ NaCN + AgNO_3 \rightarrow NaAg(CN)_2 + 2\ NaNO_3 \quad (5)$$

or

$$NaCN + \tfrac{1}{2}\ AgNO_3 \rightarrow \tfrac{1}{2}\ NaAg(CN)_2 + NaNO_3 \quad (6)$$

As soon as all the Sodium Cyanide is used up, (Equation 5), the next drop of Silver Nitrate reacts with any Iodide present and forms a precipitate Silver Iodide. The important point to be noted is the ratio of 1 molecule of $AgNO_3$ to 2 molecules of NaCN (left side of equation 5).

The second method, the Silver Chromate (color) method, is carried out in nearly neutral solution. The following reactions take place:

$$2\ NaCN + AgNO_3 \rightarrow NaAg(CN)_2 + NaNO_3 \quad (7)$$

$$NaAg(CN)_2 + AgNO_3 \rightarrow 2\ AgCN + NaNO_3 \quad (8)$$

Adding Equations (7) and (8):

$$2\ NaCN + 2\ AgNO_3 \rightarrow 2\ AgCN + 2\ NaNO_3 \quad (9)$$

or

$$NaCN + AgNO_3 \rightarrow AgCN + NaNO_3 \quad (10)$$

$$2\ AgNO_3 + K_2CrO_4 \rightarrow Ag_2CrO_4 + 2\ KNO_3 \quad (11)$$

Again, the important point to be noted is the ratio of 1 molecule of $AgNO_3$ to 1 molecule of NaCN (left side of equation 10).

Thus if equal volumes of Sodium Cyanide are placed in two beakers, and if the first is titrated by the cloud method and requires, for example, 9.4 ml. of Silver Nitrate, then the second beaker, by the color method, will titrate twice as much (18.8 ml. of Silver Nitrate). In other words, the titer value of the same Standard Silver Nitrate solution is twice as great by the cloud method as by the color method. There is no discrepancy, or error.

Perhaps the advantage of the color method over the cloud method lies in the fact that impurities which may cause the formation of precipitates (ferrocyanides and ferricyanides) will give low results by the cloud method.

The Silver Chromate (color) procedure was studied to determine the most satisfactory amounts of Sodium Bicarbonate and Potassium Dichromate to use. For a one-ml. sample of Cadmium Cyanide solution, 8 to 10 grams of Sodium Bicarbonate (especially for high total cyanide) and 0.3 grams of Potassium Dichromate were found to be best.

However, the amounts of Sodium Bicarbonate and Potassium Dichromate may be varied within limits, so that a 12 gram portion of Sodium Bicarbonate is recommended for unknown test solutions.

Sodium Bicarbonate reacts with sodium hydroxide, as follows:

$$NaHCO_3 + NaOH \rightarrow Na_2CO_3 + H_2O$$

100 ml. of water dissolve 8 grams of Sodium Bicarbonate. The 0.3 gm. portion of Potassium Dichromate was selected by a majority of the analysts, for routine titration.

Distillation Procedure for Total Cyanide

For determining Total Cyanide, another alternative method is available. The sample is placed in a 100-ml. distillation flask, acidified with Sulfuric Acid, diluted with water and the Hydrocyanic Acid distilled into water. At least two distillations are required. The distillate may then be titrated with Silver Nitrate, by either the "Cloud" or the "Chromate Color" method, and the result calculated.

Common errors in this type of procedure are the difficulty in distilling all of the Hydrogen Cyanide, the

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* *Cadmium Hydroxide is insoluble in Sodium Hydroxide solution, but soluble in Sodium Cyanide. If the cyanide is removed (as by Silver Nitrate), Cadmium Hydroxide will precipitate:*

$$Cd(CN)_2 \cdot 2\ NaCN + 2\ AgNO_3 + 2\ NaOH \rightarrow Cd(OH)_2 + 2NaAg(CN)_2 + 2NaNO_3$$

necessity of decomposing Cuprous Cyanide, and the partial decomposition of Hydroferrocyanic Acid.

The distillation procedure is used for "umpire analysis," but for rapid routine determinations the "Chromate Color" method offers reproducible results.

Procedure for the Determination of Total Sodium Cyanide by Silver Chromate (Color) End Point Method

Pipette a 10-ml. sample into a 100-ml. volumetric flask, dilute to the mark with water, and mix well. From the volumetric flask, pipette out a 10-ml. aliquot portion and transfer to a 300-ml. beaker, or 300 ml. Erlenmeyer flask. Add 100 ml. of water, 12 gm. of Sodium Bicarbonate (c.p. only) and 3 ml. of Potassium Dichromate solution. Stir until most of the bicarbonate has dissolved. Titrate slowly with 0.229 N Silver Nitrate Solution (dropwise, near the end point), until a permanent red color remains after the precipitate has been allowed to settle for 10 seconds.

Blank Determination

Sodium Chloride causes slightly high results. Run a blank on a one-ml. sample of the water that the plater uses to make up the plating bath. Subtract the reading (if any) from the silver nitrate reading obtained above.

Calculation:

$$\text{Total NaCN, oz. per gal.} = \text{ml. } AgNO_3 \times 1.5$$

Procedures for the determination of free Sodium Hydroxide and for Sodium Carbonate were detailed in a previous paper (4). The author has no really satisfactory procedure for the determination of "free" Sodium Cyanide in Cadmium Cyanide plating solutions. By accurately determining the total Cyanide, as NaCN, and the metallic Cadmium contents, the "free" Cyanide may be calculated. However, as most Cadmium baths are controlled by their ratio of total Sodium Cyanide to Cadmium, this calculation is not usually required except for research purposes.

Solutions Required

Iodate—Iodide Standard Solution, 0.1 N

Carefully weigh 7.134 gm. of potassium iodate. Transfer the salt to a 2-liter flask, add about one liter of water and shake until the iodate dissolves. Add, first about two gm. of sodium hydroxide and follow with 200 gm. of potassium iodide. Shake until all the solids dissolve, dilute to the mark with water, and mix well. If the iodate is carefully weighed, the solution need not be standardized. The amount of potassium iodide is more than is really necessary, but better results are achieved using this amount.

Sodium Thiosulfate Standard Solution, 0.1 N

Weigh 50.0 gm. of large crystals of $Na_2S_2O_3.5H_2O$. Transfer to a 2-liter flask, add two gm. of sodium benzoate and dissolve the salts in water. Dilute the solution to the mark with water. Store the solution in a dark bottle, away from sunlight. The solution "stabilizes" after three weeks. Prepare two or more solutions, so that they may be properly aged, and used as desired.

The sodium thiosulfate solution is standardized against the iodate-iodide solution as follows:

Pipette 25 ml. of the standard iodate-iodide solution into a 400-ml. beaker, add 100 ml. of water and 5 gm. of potassium iodide. Stir to complete solution. Pour in 15 ml. of hydrochloric acid (sp. gr. 1.2), stir and titrate at once with the thiosulfate solution, until the deep brown iodide color nearly disappears. Add one ml. of starch solution, and continue titrating until the blue solution becomes white.

Calculation:

$$\text{Normality of Thiosulfate Solution} = \frac{25 \text{ ml.} \times 0.1}{\text{ml. thiosulfate used}}$$

Silver Nitrate Standard Solution, 0.229 N

This solution contains 38.9 gm. per liter of water. It should be carefully weighed, and used as standard reagent. The normality 0.229 is chosen because it may be used for the free cyanide and total cyanide determinations of cadmium, silver, copper and zinc.

If one ml. of cadmium cyanide solution is titrated by the color method, the value for each ml. of silver nitrate solution is 1.5 oz. per gal. of NaCN, but by the cloud point method it is 3.0 oz. per gal. If a 10-ml. sample of cadmium cyanide solution is used, then one ml. of silver nitrate solution equals 0.15 oz./gal. of NaCN (color method).

Potassium Dichromate Solution, 10 Per Cent.

10 gm. dissolved in 100 ml. of water.

Starch Solution

Weigh 5.0 gm. of arrowroot starch, transfer to a 150-ml. beaker and make into a thin paste with 50 ml. of water. Pour the starch mix into 500 ml. of boiling water, and maintain near the boiling point for 15 or more minutes, stirring occasionally. Cool the solution, add about one gram of sodium hydroxide and several drops of chloroform. The solution will keep for 30 days.

Sodium (hydro-) Sulfide Solution

Dissolve 15 gm. of sodium sulfide in 100 ml. of water.

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All Our Yesterdays—Part X

By George Spelvin

IN AT least one sense America came of age in 1912, for that was the year in which the forty-seventh and forty-eighth states were admitted to the Union: New Mexico on January 16 and Arizona on February 14. And now the full-grown republic began to throw her weight about in international affairs: Taft warns Cuba we will intervene if unrest continues; U.S. battleship ordered to Ecuador to protect American interests; U.S. troops land in China to guard Peiping-Tientsin railroad; troops ordered to Mexican border; marines land in Honduras. All these headlines, or their equivalents, appeared during the first two months of the year. Later, marines landed in Cuba; we intervened in Santo Domingo; Great Britain protested her unequal treatment in the matter of Panama Canal tolls; etc. On the domestic scene, there were the usual number of strikes, with the center of labor unrest shifting to the textile mills of New England; in Lawrence, Mass., alone 25,000 workers struck against a pay cut, and in spite of the militia, won their demands.

Electroplating was coming of age, too, but more gradually. One of the leaders in the industry, *Charles H. Proctor*, took stock of the situation in an article rather inclusively titled "*The Future, Present and Past of Electroplating.*" Quote:

"For years the art has remained practically dormant chemically. Very little has been accomplished since the days of Elkington, Becquerel, Roseleur, and others whose methods and formulas have remained practically standard up to the present time.

"But a new era lies in the future. On every hand it is gratifying to note that electro-chemists and metallurgists, who have devoted the product of their brains to the mining industries for years past, are now turning their thoughts to the greater possibilities of the electro-deposition of metals . . . So it behooves the younger generation, who expect to take up the art of electro-plating in the future to make a thorough study of chemistry and electricity. Adding to these arts such mechanical skill as he possesses, the plater of the future will then be able, with his superior knowledge, to successfully cope with any difficulty that may present itself.

"The present of electroplating is upon a satisfactory basis, so much has been accomplished in a mechanical way in the past decade. Mechanical plating tanks and barrels of almost endless variety have been put on the market . . . By the application of mechanical electroplating much has been learned that heretofore has not been thoroughly understood. Constant friction by agitation caused greater internal resistance and necessitated denser solutions and greater voltage, to produce results as satisfactory as those secured from the still solutions formerly employed . . .

"The platers of the United States and Canada should feel highly gratified that they have been able to maintain a standard of finishes quite equal, if not superior, to those of any other country. Germany, France and Austria, however, have paid more attention to chemical detail. England has followed the lead of the United States, but pays more attention to the uniformity of deposit . . .

"The old myths of unsatisfactory deposits being due to too much sunshine, too much cloudy weather and a hundred and one other imaginative thoughts, have, like the myths of the middle ages, been explained by scientific study of cause and effect. Unfortunately, while many of the old concerns have modernized their mechanical productive departments, they have sadly neglected their plating departments. The owners of such plants wonder why they do not produce the same results as their more modernly equipped competitors . . . Give the progressive plater modern methods and he will undoubtedly produce results . . .

"The National Electro-Platers' Association has been of untold mutual advantage to its members, producing results from exchange of thoughts, ideas and experiences . . . What is required is a greatly increased

Figure 1. View of the chemical laboratory in the school for platers organized by Herman Reama and Allen Field in 1912.

membership to accomplish the results desired by the Association. If Andrew Carnegie or some other great leader in the metal world could understand its requirements there is no doubt their financial assistance would be forthcoming to maintain the art of electroplating in this country in the foremost rank of the world."

There could be little doubt that the success of the National Electro-Platers' Association was now assured and that it would do much to put the trade upon a more firm scientific foundation. An editorial tribute to the young organization summed up the matter:

"To say that the growth of the National Electro-Platers' Association of the United States and Canada has been marvelous would not fall far short of the truth. A society formed in 1909 by a small number of platers and others interested in the uplift and advancement of the plating industry, has now grown until it is a powerful factor in the art of finishing metals. From the small beginning noted in March 1909, it has expanded until it is now a national body, in fact as well as in name. The association now lists over three hundred members . . . and has seven very enthusiastic branches . . .

"An enormous amount of painstaking labor had to be performed before the organization became a fact rather than a theory. Obstacles arose that were not thought of; personal differences had to be smoothed over; a thousand and one questions had to be answered by tact and diplomacy, but finally commonsense and the actual need for the society prevailed and then 'Those who came to scoff remained to praise . . .'

"One of the most important results growing out of the work of the society to date has been the breaking down of the bars of mystery surrounding the deposition of metals . . . There has been a growing belief, and this has strengthened into a conviction, that a plater today, to be successful, must also be a chemist, sufficiently educated to at least know and understand the chemical phenomena attendant upon the plating operation . . ."

Loyal readers of this series may remember that the last installment noted a plaintive letter to the editor, entitled "*A Plater's Plaint*," which bemoaned conditions in the industry and suggested that in order to better their status platers should, literally, make themselves scarce: they should not teach the dark arcana of their art to anyone, and thus their own value to their employers would not be placed in jeopardy. That anonymous author appears to have struck a responsive chord, for soon the correspondence columns overflowed with the adverse criticism of his colleagues on the subject. We quote some samples:

". . . You do not go into the water and expect to remain dry. You cannot work at plating and expect others to let you alone; even though it be a far more disagreeable class of occupation, others will vie with you for its attainment. The reason is apparent: Every man is anxious for himself and family to keep from want, and no man, this particular plater included, will stand aside and let others work while he seeks

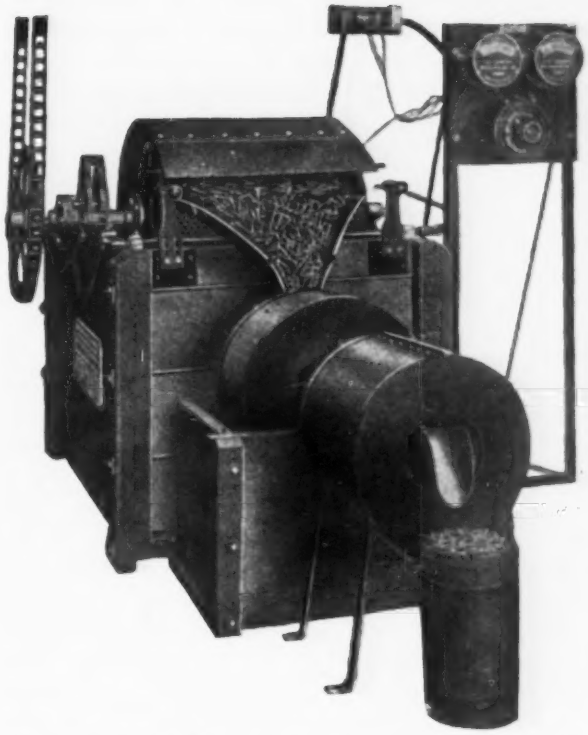

Figure 2. A barrel plating machine in use in 1912 for complete cycling during zinc plating.

in vain for employment . . . Five million men are out of work in the United States. They are all after our jobs—can you blame them? The Plater's Plaint proposes a very feeble remedy for this state of affairs . . . The remedies that are applicable under our present system of industrial life are but two, one of them positive and the other negative, according to who looks at it, either employer or employee, reversing the polarity to each other. One remedy is to so improve yourself that you are constantly in demand. The other is, lower your wage rate so as to be constantly in demand . . ."

And another objection:

"I cannot agree with the author either as to conditions or remedy. Considering the fact that the National Electro-Platers' Association were compelled to withdraw their advertisement from the trade journals because they were unable to supply the demand for platers, it would seem that good platers would have no difficulty in securing positions . . . I believe the majority of the unemployed platers in the country today are lacking in some of the qualities that make for a desirable man in the plating shop . . . I have no fear that the other fellow will get my position as long as I keep up with the times and pay strict attention to business."

But there was agreement, too:

"I have read with interest the article entitled 'One Plater's Plaint,' and being a plater myself of some twenty years' experience up and down country and in all classes of shops, mostly as a foreman, I can fully endorse every word of "A Plater." I have been placed in the same position as your correspondent states;

namely, after having a green hand in the shop and teaching him sufficient of the trade to carry it on in my absence at any time, I have found that my job was always hanging in the balance and in one or two cases it has weighed down on the green hand's side, not from experience, but cheapness. One very great fault in our trade, and one that should be discouraged, is the way firms who supply platers' materials have of imparting information to employers as regards the making and working of solutions, a sort of 'you buy our stuff and we will keep your solutions in order for you and you can then employ cheaper labor,' to the detriment of the men who have perhaps studied hard for years and mastered every detail of the business, and also to the detriment of the boss, who soon begins to lose his connections, due to the bad and inexperienced labor.

"Another setback to the experienced plater is the number of books on electroplating, and given a book, a little knowledge in the plating shop becomes very dangerous. I have had employers tell me that anyone could do plating from a book, and there lies one of the secrets of cheap labor. Technical schools again have had a lot to do as regards lowering the status of our trade by turning out yearly numbers of half-taught young men eager to chance their arm in some electroplating shop. I say 'half-taught,' for in all my experiences I have never yet found a thoroughly qualified all-round metal finisher that came from a technical school. One more thing, Mr. Editor, and I will be done; that is, why cannot the insane practice of price cutting in our trade be stopped? Firms I have worked for have taken on work at a loss, simply for the reason that the firm across the way should not have it. And who has to suffer for this in the long run? Why, the skilled employee, for low-priced work must and does mean scamped work and also cheap labor. Another thing that should be stopped is the employment of female labor, great quantities of which exist . . . I have tried my best to show the existing state of things in the trade, but hope someone more capable than I am will take this up with the result of making things a little better for us.

"Another Plater"

And finally:

"It would seem, Mr. Editor, that the author of a Plater's Plaint must be suffering from a disease which has been common to platers in the past and one which time does not seem to have cured. He claims that there are too many platers, and his argument is in itself an admission of the fact that he is up against it, for unless he surrounds himself by a competent set of men, the quantity and quality of his work will suffer, and he is continually the recipient of complaints from his superintendent or the office, and shortly is looking around for another position . . .

"Don't teach anyone! Don't help anyone to learn! Mr. Editor, the past has seen too much of this . . . My remedy for Plater's Plaint then would be: Make yourself and your men so valuable to your employer that he cannot afford to lose you, and do this by surrounding yourself by men who will use every effort to master the business and help them to become so by an earnest effort to teach them and allow them to be taught. The standard of the plating business is more and more becoming higher, and we must take good care, brother, to keep it up to that standard or we will be out of it."

It is easy, from our vantage point in 1949, to dismiss this exchange of opinion with a superior chuckle, but its significance for the advancement of electroplating—its emergence from the status of black magic to that of a modern engineering technique—to say nothing of what it says about a worker's security, should not be minimized.

The writers of letters to the editor were concerned with specific problems as well as with the philosophy of their trade. An article concerned with the subject of *Electricity in the Plating Room* had, rather in passing, suggested that if the plater could afford only one measuring instrument a voltmeter would be more valuable than an ammeter. At least one reader didn't think so:

". . . As this is an error of long standing, I wish to say the following experiments will show that the voltmeter is quite unsuitable for the purpose intended. Fill a tank full of work, and fix the rheostat where it will be about right for the work. Now read your voltmeter; also read your ammeter. Next, without changing your rheostat, take part of the work out of your tank and you will notice that your voltmeter goes up while your ammeter is going down, so you see the ammeter is doing your work right.

"Again if 100 pieces of work will plate properly at 2 volts, what will 1 piece plate at in the same tank? Surely not 2 volts, as the resistance is so changed that it would burn 1 piece at the same voltage. But if 100 pieces of work take 200 amperes to plate them properly, then 1 piece will plate properly at 2 amperes in the same tank or any other tank. Thus it appears to me that the ammeter is the proper instrument, if you only have one."

The original author did not immediately reply, but another reader was ready to come to his defense:

". . . The writer would say that the previous correspondent evidently has a lot to learn about the rheostat, voltmeter and ammeter. What is the sense of filling the tub full of work and fixing the rheostat 'about right' for the work, when a voltmeter is used which tells just when the voltage is right? He does not mention the metal that is supposed to be plating on the one hundred pieces at two volts, but I would judge it to be silver.

"My plan would be to fill the tub with work, then regulate the rheostat by the voltmeter until it reads one volt. Then take out part of the work and the voltage goes up. It is then time to regulate the rheostat until the voltage again reads one volt, there being no guess work . . .

"All solutions having a standard voltage, the voltmeter not only tells when the voltage is right, but tells when the tub needs metal . . . It also indicates when the belts are slipping and if there is a short circuit . . ."

Did anyone suggest that the plater might splurge

and buy *both* instruments? No: the original author of this teapot hurricane now entered the fray:

". . . Suppose that he has 100 pieces of work in his tank and he has his voltmeter connected across the tank showing two volts, then by removing nearly all of his work he can again adjust his voltage by means of the voltmeter and the rheostat so that he gets the same voltage . . . It does not matter in regard to the amperes, for if he got a satisfactory plate on his work at two volts, when he had the 100 pieces in the tank, and then removing 99 pieces he again adjusts his voltage to two volts, he would get the same satisfactory plate . . . Of course, an ammeter will tell just the amount of current that is being used in turning out this work, but it is of no use to a plater as an aid to adjust the voltage of his dynamo . . ."

And the pro-ammeter critic had a final word:

"I am aware that I have a great deal to learn about rheostats, ammeters and voltmeters. That is the reason why I subscribe for and read this journal . . . But as Mr. ——— has seen fit to attack me on the silver question, conceding everything he says, you can certainly do all these things with an ammeter. Besides with an ammeter one knows that for every ampere that is going through the solution for one hour, that . . . sixty-two and one-half grains of silver are being deposited upon the work. Can Mr. ——— tell me how much he is depositing with one volt or would he have to go to the ammeter to find out?"

Has it occurred to you that the readers of 1912 seemed eager to dash into battle in the pages of the technical press in defense of pet theories or refutation of others? That thought occurred to a correspondent who unburdened himself on the topic of critics:

". . . I fain would register a kick against the unfriendly attitude displayed by many of the critics who oftimes, without rhyme or rhythm, seek to disqualify what has been written, by uttering caustic remarks, and frequently make statements that are no more correct than those they seek to criticize.

"It is seldom that an article on which much time and thought have been spent escapes the prod of the man who, not in so many words perhaps, tells us why *he* could have written that paper much better than the author, and would have done so had he only thought of it in time. He will then siphon off some of the solution in his think tank, which to him looks clear, but usually contains a copious precipitate of exaggerated ego . . .

"I find, under the head of '*Acid Copper Solutions*' that the various authors recommend the addition of everything inorganic, from whiting to scrap iron, except sulphuric acid; while in organic chemicals they consume everything from candy to the slaughter house products, to brighten the deposit or make it smooth, and judging from what I have seen, I would certainly hesitate to say that all of those mysterious mixtures are not twenty-four carat fine, if the local conditions were known."

The writer goes on to relate that he knows of several copper sulfate baths, each operated differently but each in conformity with good practice for the particular conditions involved in each case. And he draws the moral:

"Yet were these platers to meet and compare notes, they would find that each pursues an entirely different course, and they are both right.

"Here we have three acid copper baths that are being intelligently worked by competent platers, yet your critic could and would shoot their story full of holes, were they to write of their simple methods. There is no doubt but that glue, dextrene [sic], alum, and other slippery messes have their uses, even in copper solutions; yet it is a fact that good work can be done without their use, if the operator will only use his brain and a voltmeter occasionally. Too often published formulas and receipes for plating sound a good deal like old Widow Benning's cake recipe, which is as follows:

A little crumb of sugar
A little dust of flour
A little drop of milk
A little dab of butter
Do it down pretty considerable heavy
Bake it with a right smart fire."

At 11:38 p.m. on the night of April 14, 1912, a great ocean liner, the pride of the White Star fleet, was steaming calmly on its voyage from Liverpool to New York carrying a full complement of passengers, including many famous and influential personages. Two minutes later this proud vessel, named by its builders after the Titans of old, had met its doom in the shape of an iceberg. Within three hours the ship had gone to the bottom, and on the morning of the next day the Cunard liner Carpathia picked up twenty boatloads of survivors: 705 out of the original 2,340. To an age not inured to mass destruction, this loss of 1,635 lives came as a sickening shock; and it is still remembered as one of the greatest peacetime disasters in history.

The *Titanic* story overshadowed other news events of the year; but 1912 is memorable on other counts. It was a Presidential year, and the nominating conventions of the major and minor parties met early. So soon as February, Theodore Roosevelt announced that he was a candidate for a third term (is there something about the name Roosevelt?). In April the Socialist Labor party nominated one Arthur E. Reimer, and in May the Socialists placed at the head of their ticket their great leader, Eugene V. Debs. In June the regular Republicans renominated Taft and Sherman, and TR promptly proceeded to form a third party in protest. At the beginning of July the Democratic convention was deadlocked by its two-thirds rule, but on the 46th ballot the Great Commoner, William Jennings Bryan, announced in favor of Woodrow Wilson, who was forthwith nominated. Weary of deadlocks, the delegates named his running mate Marshall by acclamation. Later in July the Prohibition party chose one Chafin as its standard-bearer. In August the Progressives officially nominated Theodore Roosevelt and Hiram Johnson, and the campaign was on.

How to make the transition from politics back to

electroplating again? An author of the day does it for me, by neatly tying in a political campaign with the art of cleaning metals:

"In methods of cleaning metals for plating, as in the politics of today, there are standpatters, progressives and insurgents. Standpatters, or reactionaries, as they are sometimes called, still preach the doctrine of twenty years ago, and maintain that so long as a deposit is adherent, there can be no reason for experimenting with new-fangled ideas, and paraphrase the standpat politician's motto to read, 'What is good enough for Roseleur is good enough for me.' They point with pride to their platform (Langbein folio 131, Removal of grease) which proclaims caustic potash and lime the only desirable and regular way of procuring a plating surface . . .

"Reactionaries who refuse to see the advantages of electric cleaning will probably bolt when the statement is made that iron and steel should always be cleaned by electricity. . . . Caustic potash, especially where iron castings received in a filthy condition are to be plated, is still of great value. On stove work with buffing compounds incrusted in the deep recesses, it is what the Cascaret is to humanity . . .

"The following rules will be found to work on most cleaning solutions:

"1. Keep up the strength . . .

"2. When a cleaner works badly, apply the initiative, referendum and recall.

"3. If your electric cleaner won't work with a direct current, be an insurgent and reverse the current.

". . . 6. If you can't get results with these cleaners, apply the steam roller; it's popular at present."

There was a promising new development in rack coatings:

"In plating articles on racks, it is always desired to keep the metal from the racks as much as possible. . . . In a number of plating establishments, the use of celluloid is now being tried and so far it has given very good satisfaction . . ."

One reason why the development of commercial alloy plating has been so slow is evident from the discouraging tone of these observations:

"As considerable interest seems to be displayed at the present time in regard to the electrodeposition of an alloy of silver and cadmium, a few remarks upon the subject may be opportune. While this subject at first seems attractive, a realization of the conditions which must be met, and the difficulties which are confronted in depositing the two metals simultaneously, will surely result in a different view of this apparently attractive process . . .

"The process was at one time carried on in England, but as far as known was never a commercial success. . . . It is not carried on at the present time.

"The difficulty with the process is that it is almost impossible, from a commercial standpoint, to maintain the proportions of the cadmium and the silver in the deposit. They are both white and there is no way of ascertaining, except by chemical analysis, whether more or less cadmium or silver is depositing . . . It has been found by some who have tried it that the deposit is very variable and uncertain, and there is no method known of ascertaining whether the right proportion of cadmium and silver is depositing except by analysis which, of course, would hardly do as a commercial proposition while the plating is going on . . ."

When you saw the bill for your new 1949 automobile did you exclaim "For that dough it ought to be silver-plated"? In 1912 one editor thought he detected a trend:

"The value of silver-plated lamps and automobile hardware was mentioned some time ago and it is pleasing to note that some of the leading automobile manufacturers have realized that silver plating is superior to nickel plate for this class of work. A number of manufacturers are to use it next year quite extensively for their work.

"The tendency in automobile manufacture is toward white hardware and the coming year will witness nearly all cars equipped with nickel plated lamps and hardware . . . One maker of automobile and carriage hardware recently said that it seemed to him it was only a short time hence when the automobile trade would call for as close-plated silver hardware as the fine grades of carriages and coaches now have for their equipment . . .

"It is believed the silver plating era in automobile manufacture has arrived and will tend to beautify the car as well as decrease the labor required to care for it."

Some arguments are classic in any field, and two of them in the plating art have to do with the relative merits of hot-dip vs. electro-galvanizing, and potassium vs. sodium salts. Both received attention in 1912.

"The coating of iron or steel by dipping them into a bath of molten zinc is far from being a satisfactory process. Neither is it a reliable protection from rust or oxidation. The coating is of a porous and granular nature, and instead of acting as a preventative of rust really helps the corrosion to become more rapid

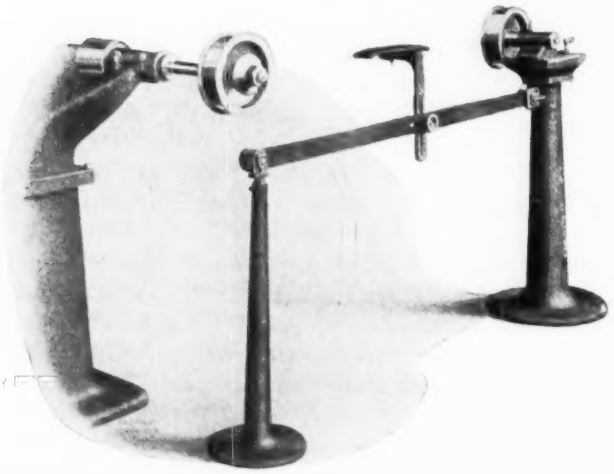

Figure 3. Polishing backstands are not as new as most modern finishers think. Here's one type in use over 35 years ago.

through the moisture of the atmosphere and the chemicals used. The use of ammonium chloride and the chloride of zinc is unavoidable, and the combined salts cause the coating to corrode, in case of mechanical injury, from the inside to the outside, notwithstanding the thickness of the coating given . . .

"The development and perfecting of the cold, electro-galvanizing process has almost to a great extent replaced hot galvanizing.

[Editor's Note: *For the first satisfactory explanation of what is meant by the phrase "almost to a great extent" we will award, as first prize, a lock of George Spelvin's hair, which he tore out trying to figure it out himself.*]

"The results are more satisfactory and uniform . . . The advantages of the cold process over the hot are many, all of them good, but one which is important is the economy of the process . . ."

The author cites some results of the Preece test, and concludes with as unequivocal a statement of the issue as you could desire: "This proves conclusively that articles coated by electrolytical processes are superior to those galvanized by the hot process."

As for the sodium-potassium controversy, much was being made of the supposed fact (referred to also in our last instalment) that potassium salts tend to deliquesce and are therefore responsible for a great deal of spotting out trouble—but let the author of this theory speak for himself:

"In 1906 the use of sodium cyanide in electroplating was exploited for the first time . . . Since that time platers have given the cyanide a trial with the result that it is now extensively used in the plating trade for all classes of work . . . At first, silver platers did not take kindly to the sodium cyanide. Silver plating is such a delicate operation, and so much depends upon the silver deposit that chances could not be taken, and it was some time after sodium cyanide made its appearance on the market that it was tried in the silver plating trade. Gradually, however, it became used until now the silver trade is using it regularly and some of the most conservative manufacturers have adopted it exclusively. The results obtained by it have been found identical with those produced by the potassium cyanide or the double potassium and sodium cyanides.

"The advantage of sodium cyanide lies in the fact that it is cheaper than the potassium cyanide. Sodium compounds are always cheaper. It is cheaper from the fact that it has greater dissolving power and it takes less to dissolve a given weight of copper carbonate or silver chloride. In addition to this, it has another advantage, not generally appreciated, in that it does not spot out when used in making a copper or brass solution for plating cast or malleable iron. The reason is that sodium compounds give off their water upon exposure to the air, while potassium compounds do not. When the plating solution oozes from the pores of the casting, it dries, becomes a powder and may be brushed off. Potassium compounds absorb water from the air, liquefy and spread over the surface producing the well known spots."

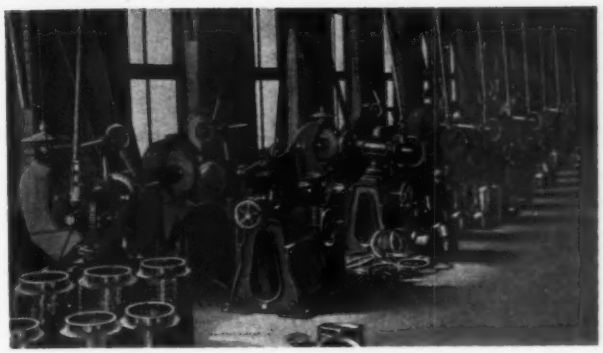

Figure 4. Automatic buffing machines at the Badger Brass Co plant in 1912. Twenty-four of these were in use here.

One is tempted to quote further from the many technical articles and helpful hints which meet us as we leaf through the old files, but space grows short: we must turn to the question-and-answer columns for our final glance at the state of the art in 1912.

Q: Can you advise me where I can secure the details of a first class system for ascertaining the cost of articles to be plated? A: No cost system has ever been evolved for a plating department.

Q: I desire to oxidize some brass-plated steel work with ammonia and carbonate of copper. I made the solution, but it took all the brass off the steel. At the same time I know the dip is good as it works on solid brass. Will it work on brass-plated steel, or is there some reason why it will not? A: Brass is brass, whether it is solid metal or plated, and the dip will work as well on brass-plated steel as on solid brass. Your difficulty is that you have too light a brass deposit. Give a heavier one and you will have no trouble.

And to show that foundrymen could ask foolish questions (and receive snappy answers) as well as platers:

Q: I want to make an ornamental casting of aluminum, but desire it a different color and still have it as light in weight as I can. What would you advise me to use? A: We advise you to make a wooden one and coat it with bronze paint! Your question is rather silly as everyone knows that all the colored metals are heavy. What you are seeking is the philosopher's stone which alchemists of old believed would change lead to gold!

The last time I looked, tin was $1.03 a pound. In 1912 there were at least two articles dealing with attempts to find a substitute for tin, and they both began, "The present abnormally high price of tin . . ." (Tin was 49.5¢ per pound in 1912 . . .).

And since we are on the subject, here are a few want advertisements of the year:

WANTED: Foreman for Nickel plating department. Wages $18.00 per week . . .

FOREMAN PLATER at present in charge of 10,000 gallons of plating solution, desires to change, where executive ability is appreciated. Salary $1,500 per year . . .

A note of sarcasm:

SITUATION WANTED, by a foreman plater on

(*Concluded on page 74*)

Surface Quality of Zinc Die Castings

By James L. Erickson, *Production Die Cast Co., Grand Rapids, Mich.*

THE technical literature of the past two years has called attention to the manifold problems encountered in the production of plated automotive hardware of zinc-base alloy die-castings which will render satisfactory outdoor service (references 1-14).

Representatives of the automotive industry have indicated that the automotive hardware which they have been receiving from the die casting industry during the past few years has not been completely satisfactory, as demonstrated by the fact that some of it has corroded prematurely, thereby losing all of its ornamental value on the vehicles. Various reasons have been offered for (1) the corrosion itself, (2) the early onset of corrosion in the service-life of the part, and (3) the variability of the rate of corrosion in similar environmental conditions.

In all the pertinent published literature that has come to the attention of the writer, little mention is made of the possible effect of die lubricants on the ultimate ease with which zinc base alloy die castings may be plated, or on their subsequent service life. Some die lubricant manufacturers have recognized their importance, however, and have developed compounds designed specifically for zinc alloy castings. There are now available non-staining, non-carbon-forming lubricants which promote good surface finish on the die casting by preventing the formation of excess zinc oxide on the die cavity face—and in so doing contribute to the production of zinc base alloy castings with readily platable surfaces.

On the other hand, in one industrial conference* *Mr. J. C. Fox,* of Doehler-Jarvis Corp. pointed out that many types of oils as well as bromide-containing coating materials are most unsatisfactory as die lubricants, the latter causing flow marks to become overly apparent on subsequent buffing. In the writer's opinion these observations must be put to use if certain of the plating difficulties are to be avoided.

* *General Motors Joint Industrial Conference on Plating Zinc Base Alloy Die Castings.*

Figure 1. (Above) Deep seam lines caused in part by the use of excess die lubricant which chilled the molten metal and die face. This defect cannot be removed by polishing.

Figure 2. (At right) Cracks caused by uneven ejection of the hot casting. These can be avoided by use of die lubricant. Cracks such as these cannot be polished out and lead to serious trouble in the plating department.

Indeed, no lubricant which contains graphite or leaves a carbonaceous residue on the die cavity surface should ever be employed with zinc alloys. The same is true of lubricants which leave a loose residue on the die cavity face or attack either the die steel or the die casting metal itself. Portions of such films or corrosion products tend to dislodge and adhere to the surface of the die casting where their presence gives rise to inferior plating results. A die lubricant which does not react in this manner can, if properly applied, actually promote the successful plating of zinc-base alloy die castings. It can do this because it tends to minimize the occurrence of such undesirable defects as (1) drag marks, (2) cold-laps and cold-shuts, (3) deep-seam lines, (4) flow marks, (5) surface porosity, (6) "flowers," and (7) sponge spots—all of which when present have to be polished out with abrasive, not only at extra cost but also at the risk of opening up sub-surface porosity.

The use of any die lubricant which tends to leave a tenaciously adhering film on the surface of the die

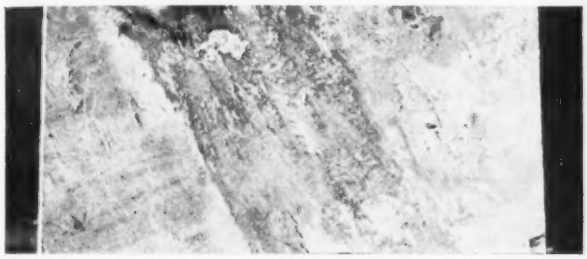

Figure 3. Discoloration caused by use of improper die lubricant. Extensive polishing is required to remove this so that plating will adhere.

casting should be discontinued, because such films (1) necessitate extra polishing operations, and cause (2) blistering after plating, (3) pitting of the plated surface, and (4) subsequent failure of the plate in service.

The use of a satisfactory die lubricant which does not leave a tenaciously adhering film on the surface of the die castings or which does not "stain" the die cast surface may, if properly applied, serve to increase the depth of the so-called "skin," below which may lie sub-surface porosity. This desirable effect is particularly observable in the case of thick sections where the skin "effect" is predominant, as opposed to thin sections with frequently no "skin effect" at all.** The skin generally varies in depth between 0.0003" and 0.020" in the case of thick sections—a good die lubricant can increase its average depth to from 0.005" to 0.030".

Of course, even the best die lubricants, such as carnauba wax and beeswax, will cause plating troubles if improperly applied. In particular, the use of excess

Figure 4. Die lubricant which attacked the mold and caused pitting is responsible for the tiny raised spots. These require extra polishing before plating.

die lubricant leads to the formation of certain of the very defects which the use of a correct amount tends to minimize, such as (1) surface and sub-surface pores, (2) flow marks, (3) surface swirls, (4) deep seam-lines, (5) pits, and (6) stained areas which cannot be buffed out economically, if at all.

The real purpose of a die lubricant as applied to a die cavity surface is fourfold: (1) primarily it must act as a lubricant to facilitate the easy ejection of the die casting from the die cavity, (2) it must facilitate metal-flow by acting as an insulator and as a surface-tension reducing agent, (3) it must prevent the die casting alloy from welding or sticking to the die cavity face, and (4) it must prevent the build-up of oxide coating on the die cavity face. A die lubricant of the correct composition, properly and sparingly applied,

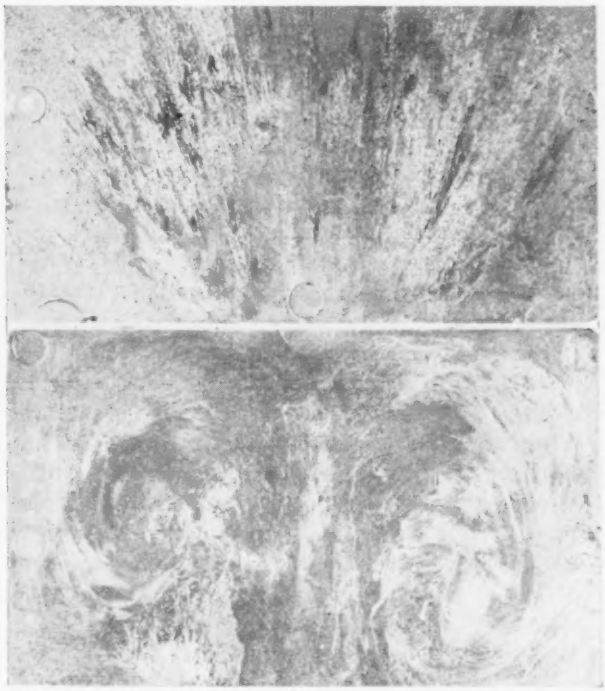

Figure 5. Panels ⅛" thick. Minimum lubricant used in the casting of the top panel, excess used in casting the bottom panel. All other casting conditions identical.

*** In thin sections the grain size is usually small throughout the section, i.e., there is no "skin effect", while in the case of thicker sections the "skin effect" is most observable due to the much larger grain size that forms below the skin forming a sharp line of demarcation.*

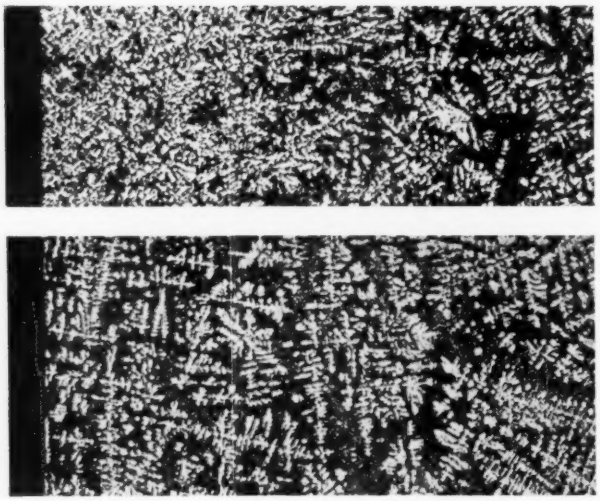

Figure 6. Photomicrographs of die castings showing in the top view the chilled surface caused by rapid cooling of a thin-sectioned casting. The grain is much coarser towards the center where cooling was more gradual. In the bottom view there is practically no difference between the edge and interior sections because the section thickness of this casting promoted more even chilling. Magnification 250x.

will achieve these ends; an unsatisfactory die lubricant will not only fail to perform its intended functions, but it will engender a host of undesirable defects that make subsequent plating most difficult.

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8. Anon., "*The Finishing of Zinc Alloy Die Castings.*" New Jersey Zinc Company, New York City.
9. E. A. Anderson, "*Plating Zinc Alloy Die Castings Commercially.*" Metal Cleaning and Finishing, July 1938.
10. Joseph Geschelin, "*AC Die Casting and Plating Methods.*" Automotive and Aviation Industries.
11. Anon., "*Applied Finishes for Zince Alloy Die Castings.*" Product Engineering, May 1946.
12. E. J. Roehl, "*Procedures for Nickel Plating on Zinc Castings.*" Technical Paper No. 145, March 27, 1946.
13. H. K. and L. C. Barton, "*Applied Finishes for Die Cast Products.*" Mechanical World, August 16, 1946.
14. L. R. Eastman, "*Polishing and Buffing Die Castings.*" Die Castings Magazine, Oct., Nov. 1944.

ALL OUR YESTERDAYS

(*Concluded from page 71*)

flat-ware or hollow-ware. Desires a position with a good firm, where mental ability and effort would be tolerated . . .

And a note of reassurance:

EXPERIENCED PLATER wishes a position, as plater and foreman of buffing department . . . Am a teetotaler . . .

So this presidential year of 1912 draws to its close. In October a maniac shot and seriously wounded Theodore Roosevelt, and Vice-President Sherman died. When the votes were counted it was found that Wilson had 6.3 million, Roosevelt 4.1, and Taft 3.5, so that for the first time since its founding the Republican party ran third, and a minority of the voters had elected a president. Also noteworthy were the high totals piled up by the minor parties: Debs 900,000; Chafin 206,000 and Reimer 28,750.

When we have mentioned that death claimed Wilbur Wright of Kitty Hawk fame, and Clara Barton of the American Red Cross; that the dirigible *Akron* exploded during flight; and that Herman Rosenthal, big-time gambler, by getting himself murdered, set off a thorough shake-up in New York's police department leading to the arrest and conviction of Lieutenant Becker;—we may say that our survey of this slice of our past is complete.

This tenth article in a series seems an appropriate place to repeat an apology with which we introduced the first one: These admittedly frivolous backward glances are not intended to deprecate either the "old-timers" of the plating trade or their technical press. We can derive a chuckle or two from their mistakes only because we stand on their shoulders and so can see further. Forty years ago could we have done any better?

Figure 5. Advertising in the early days of plating often ran similar to the above sample found in an ancient copy of Metal Industry (now Metal Finishing).

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Tanks for Stripping Anodized Coatings

Question: We are planning the installation of a stripping solution for anodizing racks made up of chromic acid and phosphoric acid, at a temperature of 150°F. Would a steel tank be satisfactory for this solution?

C. H. H.

Answer: A steel tank would not be suitable for this type of solution, and we suggest a lead lined tank for best results. Your anodizing racks can also be stripped by immersion in a weak solution of caustic soda, in which case a steel tank would be perfectly satisfactory.

Plating Spot-Welded Parts

Question: We are having trouble with some flat steel parts that have two flat pieces spot welded to them. After plating in a bright copper solution and lacquering the parts turn green around the welded bosses. Can you suggest a remedy for this problem?

C. A. T.

Answer: Your problem is typical of this type of design, where crevices exist that can trap chemicals. In the bright copper solution in particular there are wetting agents that permit pentration of the solution into deep crevices, and it is sometimes very difficult to wash them out again in the after-plating rinses. If it is possible to re-design the parts so that these bosses could be formed in the die operation, or if the bosses could be brazed instead of spot welded there would be no plating problem. About the only thing you can do with the present design is to insure thorough rinsing in boiling water after plating, if necessary directing a powerful jet of water under the bosses to completely wash out any remaining chemicals.

Cement Tanks in Metal Finishing

Question: We would be interested in learning if cement tanks have any use in plating and finishing operations.

R. S. H.

Answer: Ordinary cement tanks are not used in metal plating operations, although they would be suitable for such baths as hot or cold water rinses, emulsion cleaning tanks, or other steps where the chemicals in the bath would not attack the tank itself. There are several varieties of special chemical resistant cements that are used principally to bond acid-proof bricks together for chrome plating tanks, and perhaps an ordinary cement tank lined with such materials would prove suitable for many acid baths. The heavy weight of cement tanks would be a disadvantage in some locations, but their ease of fabrication and low cost offer interesting possibilities.

Removing Excess Brightener From Nickel Baths

Question: Due to a mistake by one of our platers we have gotten too much brightener in our nickel solution. We do not want to waste all the brightener present in the solution, and would appreciate your telling us how we can remove the excess?

H. A. P.

Answer: Take about half of your solution, filter it through activated carbon to remove the brightener from this portion of the bath, then replace the filtered portion to the main tank. Small additions of brightener may then be made to bring the bath up to proper strength.

Soldering Plating Racks

Question: In making our plating racks we drill a No. 29 hole (.136") in the spline, insert a ⅛" wire and soft solder. A large number of these come loose in use. Can you suggest a better solder or method for doing this that will keep these joints tight?

W. R. K.

Answer: You are using too large a drill for this size wire, which throws all the strain on the solder filler metal during the use of the rack. As the drill invariably cuts oversize, this makes the condition worse. Use a drill that will give a snug fit around the wire, and tin the area of the wire that is inserted into the hole in the spline. Subsequent heating and melting of the solder will then result in a mechanically stronger joint. To enable the solder to penetrate the joint properly the holes should be thoroughly cleaned free of oil or other lubricant used in the drilling operation, before inserting the wire.

Bright Dipping Zinc Die Cast Parts

Question: Can you give us a formula for a bright dip for small die-cast parts made of zinc alloy?

A. C. K.

Answer: To the best of our knowledge there is no satisfactory dip for producing a bright, lustrous surface on zinc-base die castings, although a number of treatments are available for producing a chemically clean surface suitable for electroplating. A number of proprietary bright dips are available for brightening zinc plated parts, but in this case the metal being brightened

consists of almost pure zinc, and not a zinc alloy. You can produce a bright finish on small parts in a burnishing barrel, however, and perhaps this method would be applicable to your problem.

Fishtails in Buffing Brass Parts

Question: Recently we tried to fabricate some parts by forming previously polished and buffed sheet brass stock, the idea being to save polishing and buffing down into the sharp corners of the part after the forming operation. However, some roughness developed near the bends and further buffing was necessary to smooth this out. During this second buffing operation severe "fishtailing" occurred, in spite of the fact that the original surfaces before bending were highly buffed. Can you explain what is causing this trouble and how we can overcome it?

G. S. D.

Answer: The cause of "fishtailing" is usually a small pit or inclusion in the metal being dragged out by the action of the buff. In your process of bending, the brass was deformed enough to roughen the surface and possibly expose an inclusion in the metal. You could also be getting an "orange peel" effect caused by using a brass having a large grain size. The problem can be overcome by using a small grain size brass containing no lead, as any lead present would act the same during the buffing operation as a pit, as it would easily be dragged out of the metal surface to cause the formation of a "fishtail."

Gold Plating

Question: Recently we have run into trouble with our gold plating not passing the acid test. We are plating out gold to match a 14 karat cast alloy, and our customer checks each batch to see if it will stand the 14 karat acid test. What can be causing our trouble?

L. P. L.

Answer: Not knowing exactly the strength of the acid being used to check the parts it is difficult to give a complete answer to your problem. However, gold plating which matches in color 14 karat cast gold is always higher in gold content than the cast alloy, and should withstand the same acid even better than the cast alloy. Perhaps the deposit is so thin that the acid used in the test is reaching through the deposit to the base metal. If so the remedy is quite obvious.

Chrome Plating Aluminum

Question: I would like to obtain a good text on the chrome plating direct on aluminum. Can you tell me where I might obtain such a manual?

J. C. G.

Answer: There is no single source for the type of information you require. However, the following references can be consulted for more complete information on this process:

Chrome Deposits Direct on Aluminum—*Trans. Electrochemical Soc.* 59, 429-35 (1931)

Chrome Plating on Aluminum—*U. S. Patent* 1988645 (1935)

Chrome Plating Aluminum—*British Patent* 476720 (1937)

Krome-Alume Process—*Steel* (102-64 (1938)

Hard Chrome Plating Aluminum—*Metals & Alloys*, 14, 231 (8-1941)

Direct Plating Chrome on Aluminum—*Automobile Engineer* 35, 468-508 (11-1945)

New Process for Plating Aluminum—*Metal Finishing* 44, 218-219 (5-1946)

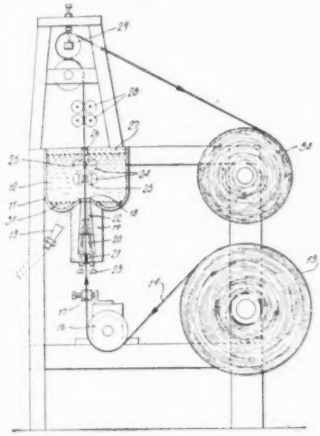
A list of firms who may be able to supply further information is also being sent to you.

PATENTS

Continuous Tinning of Steel Strip

U. S. Patent 2,458,509. *William F. Grupe, assignor to Interchemical Corp.*

An apparatus for coating sheets of steel with molten tin, comprising a tank for molten tin an elongated, slot-like opening in the tank intermediate between the top and bottom thereof so that in normal operation, the opening



will be above the level of the tin-iron alloy formed and below the level of the molten tin, each side and end of the slot carrying at least throughout its length a material that is not wet by molten tin, in such relation that the material on the sides and ends abut to form a barrier against the passage of molten tin, and a pair of rollers beneath the normal operation level of the molten tin with their axes parallel to and their bite aligned with the slot-like opening, whereby a sheet may be passed through the slot and the bite of the rolls in sequence, said rolls being provided with slotted grooves, extending axially along the rolls.

Coating Selenium Rectifier Elements

U. S. Patent 2,458,013. *Tore G. Malmberg, assignor to Allmänna Svenska Elektriska Aktiebolaget.*

In the manufacture of selenium rectifier elements in which a selenium layer is applied onto a metallic base, such layer is converted into an electrically conducting state, and a metallic counter-electrode applied over such layer, the step of treating the converted layer before the counter-electrode is applied with a compound of at least one of the metals of the group consisting of zirconium, thorium, hafnium and titanium.

Stripping Manganese Electrodeposits

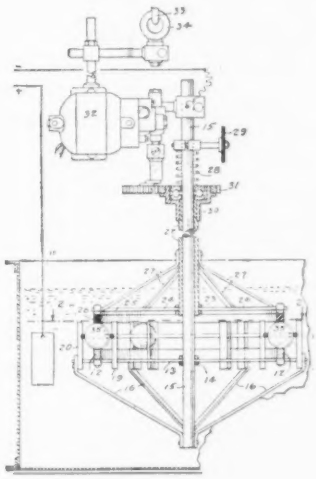
U. S. Patent 2,458,908. *James H. Jacobs, assignor to Crimora Research and Development Corp.*

That method of stripping electrodeposited manganese in large pieces from a stainless steel cathode plate which is characterized by heating the plate with the deposited metal to a temperature of about 350° C. for a period of fifteen minutes to two hours; and then breaking the deposited metal from the cathode plate.

Ball Plating Apparatus

U. S. Patent 2,458,676. *Abner Brenner anl Thelma S. Meites, assignors to the United States of America.*

In an electroplating device provided with an electroplating current supply and a suitable receptacle for a plating bath, the improvement which com-



prises a portable ball retaining device having a ring shaped cathode, a cathode supporting spider, two ball confining guide rings mounted on said spider, a friction ring of a diameter substantially the same as said ring cathode, a second spider for said friction ring, means for rotating said friction ring with respect to said cathode and resilient means for axially pressing a plurality of balls to be electroplated between said cathode and said friction ring.

Removing Carbonates from Molten Alkali Salt Baths

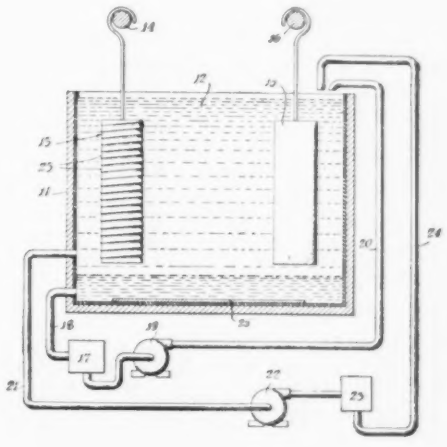
U. S. Patent 2,458,662. *Hugh G. Webster.*

A method for preserving the effectiveness of a metal cleaning molten alkali salt bath of the type wherein an excess of alkali salt carbonate is formed, either by atmospheric effects, or by chemical reactions arising during metal cleaning, which comprises removal of the carbonate from time to time as by precipitating it out of the bath and then removing it as a precipitate as follows: reducing the temperature of the bath to the solidification point, then increasing the temperature of the bath to the melting point, thus causing the carbonate, less soluble in the bath at the melting point than at higher temperatures, to precipitate out of the bath, and drop to the bottom, and quickly removing the carbonate precipitate.

Plating Lead-Tin-Antimony Alloys

U. S. Patent 2,458,827. *James M. Booe, assignor to P. R. Mallory & Co., Inc.*

The method of electrodepositing lead-tin-antimony alloys which comprise passing current between a cathode and an anode consisting of a minor portion of tin and a major portion of lead through an electrolyte consisting essentially of lead fluorborate, tin fluoborate, and a compound selected from the group consisting of antimony trioxide and antimony fluoborate, maintaining a tin concentration of 0.5 to 10 grams per liter and a lead concentration of 5 to 200 grams per liter by corrosion of the anode, and maintaining an antimony concentration of 0.1 gram per liter to saturation



by periodic addition of a soluble compound to the bath, said compound being selected from the group consisting of antimony trioxide and antimony fluoborate.

Cleaning Metals in Molten Salt Bath

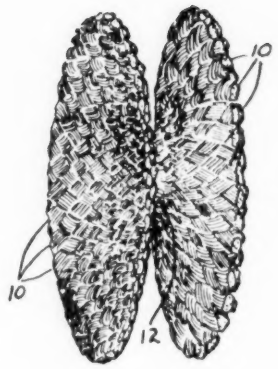
U. S. Patent 2,458,661. *Hugh G. Webster and Clarence L. Falter, assignors to J. H. Shoemaker.*

A two step non-electrolytic process for cleaning the surfaces of alkali resistant metals, wherein each step is in the nature of a chemical reaction, and wherein the second step leaves no added finish to the surface, and wherein the first step comprises immersing the metal in a bath comprising a molten mixture of one part by weight of alkali metal nitrate and from 1.5-3.0 parts by weight of alkali metal hydroxide, and from 0.1-0.5 part by weight of alkali metal chloride, for a period of time sufficient to remove any organic surface impurities and convert inorganic surface impurities to an oxidized coating, more readily soluble than were the original inorganic impurities, the operating temperature of the first bath being above the melting point of the molten mixture, and wherein the second step comprises immersing the metal in a bath of a dilute acid selected from the class consisting of hydrochloric and sulphuric acids, whereby when the metal is immersed therein for a proper period of time, the bath will react chemically with the oxidized coating to remove it, so as to leave the surface free of the original impurities and of the oxidized coating as well, the second step, however, being such as not to expose at the surface other impurities, not previously existent, or not previously exposed, thus leaving the surface free of all impurities and consisting solely of the metal, the immersion in the second bath being sufficiently brief so as not to permit the acid to attack the metal, but merely to remove the oxidized coating formed by the first step.

Buff

U. S. Patent 2,459,055. *Lawrence J. Walling.*

The method of making a buff which comprises interlacing a plurality of strands of buffing material to form a seamless tube, contracting the center



of said tube to decrease the diameter thereof, and expanding the ends of said tube and bringing them together to form a substantially flat disc.

Metal Corrosion Retarder

U. S. Patent 2,459,119. *John T. Rucker, assignor to Hooker Electrochemical Co.*

As a new composition of matter, useful as a retarder of corrosion of metals by acids, a substantially eutectic mixture consisting of lauryl pyridinium chloride and benzyl thiocyanate in substantially equal proportions by weight.

Increasing Anode Efficiency in Alkaline Tin Plating

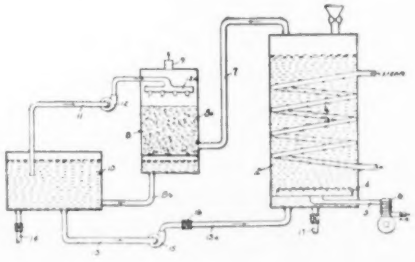
U. S. Patent 2,458,912. *Frederick A. Lowenheim, assignor to Metal & Thermit Corp.*

In the process of electroplating tin by passing an electric current from an anode to cathode through an aqueous alkaline stannate bath the step of improving the anode efficiency of the bath which comprises employing an anode consisting essentially of tin alloyed with about 0.1 to 2% of a metal of the class consisting of aluminum, gallium and manganese.

Treating Cyanide-Bearing Waste Liquors

U. S. Patent 2,459,464. *Allen S. Smith, assignor to Blaw-Knox Co.*

The process of detoxifying a waste



cyanide liquor which comprises adjusting the composition of said liquor to such extent as may be necessary to give it a pH of from 5 to 8 and ensure the presence therein of ammonium ion in concentration greater than is chemically equivalent to its cyanide content, and subjecting the liquor, at a temperature not substantially below 60° C., to oxidizing conditions effective to decompose most of its cyanide content, with formation of ammonia and carbon dioxide.

Continuous Brightening of Tinplate

U. S. Patent 2,459,674. *John S. Nachtman.*

An apparatus for treating electroplated coatings on continuous metal strip, means for preheating the strip to a temperature below the fusing temperature of the coating thereon, separate means for briefly heating the coating to a fusing temperature, separate means for quickly solidifying the coating, means for continuously moving the strip under tension and means for controlling the tension in the strip through the apparatus, whereby a uniform smooth bright tin surface is provided on the strip.

Anodizing Magnesium Alloys

U. S. Patent 2,459,365. *Geoffrey E. Coates, assignor to Permanente Metals Corp.*

A process for the electrolytic protective surface treatment of magnesium base alloy which consists of treating said alloy in an electrolytic cell wherein said alloy is the anode, the electrolyte in said cell consisting of a solution in water of from 0.2 to 0.5 mol per liter of dichromate ion, from 0.1 to 1.5 mols per liter of sulfate ion, a buffer mixture consisting of acetic acid and sodium acetate and being adapted to maintain the pH of the electrolyte within the range pH4 to pH6, the acetate ion being present in a concentration of 0.2 to 1.0 mol per liter, and the electrolyte constituents being so selected that within this pH range their cations remain in stable solution, the current density in said cell being from 10 to 20 amperes per square foot of anode surface.

Engineering Information Useful In Designating Metallic Surface Treatments

Engineering Data Sheet

Adjustment of pH in Nickel Plating Baths

The following tabulation will be found helpful in calculating rapidly the amount of acid or alkali required to adjust the pH of nickel baths from one value to another, within the range of pH 1.50-5.50.

When lowering the pH, subtract the "% by Vol. of Normal Acid" corresponding to the existing pH value (Columns 2, 4, 6 below) from the "% by Vol. of Normal Acid" for the desired lower pH. This gives the per cent by volume of 1N Sulfuric acid which must be added to the tank to bring the pH down to this desired value.

Adjusting the pH upward is similar, except that 1N alkali is substituted for the 1N acid: the "% by Vol. of Normal Acid" corresponding to the desired value is subtracted from the "% by Vol. of Normal Acid" corresponding to the existing lower value. This gives the per cent by volume of a 1N Alkali solution required to raise the pH to the desired value.

pH	% By Volume Normal Acid	pH	% By Volume Normal Acid	pH	% By Volume Normal Acid
5.5	0.0	2.85	3.70	2.15	5.4
5.3	1.0	2.8	3.75	2.10	5.6
5.1	2.0	2.75	3.8	2.05	5.9
5.0	2.3	2.7	3.85	2.00	6.1
4.7	3.0	2.65	3.90	1.95	6.45
4.5	3.3	2.6	4.0	1.9	6.75
4.25	3.4	2.55	4.1	1.85	7.10
4.0	3.5	2.50	4.2	1.80	7.5
3.75	3.5	2.45	4.3	1.75	8.0
3.5	3.5	2.4	4.4	1.70	9.0
3.25	3.5	2.35	4.6	1.65	10.0
3.0	3.55	2.3	4.8	1.60	11.0
2.95	3.6	2.25	5.0	1.55	12.0
2.90	3.65	2.20	5.2	1.50	13.0

(Data Courtesy McGean Chemical Co.)

Example: Desired to lower the pH of 350 gallons of nickel solution from present value of pH 5.1 to a new value of pH 2.50.

% by Vol. of N acid corres. to pH 2.50 = 4.2
% by Vol. of N acid corres. to pH 5.10 = 2.0

Difference = 2.2 = % by volume of Normal acid required.

As total volume of bath to be corrected is 350 gals.,
350 gals. x 2.2% = 7.7 gallons of 1N sulfuric acid required.

If concentrated 66° Baume Sulfuric Acid, which is 36 normal in strength, is used to make the adjustment, the above figure must be divided by 36; thus

$$\frac{7.7}{36} = .214 \text{ gals. (810 ml.)}$$

Recent Developments

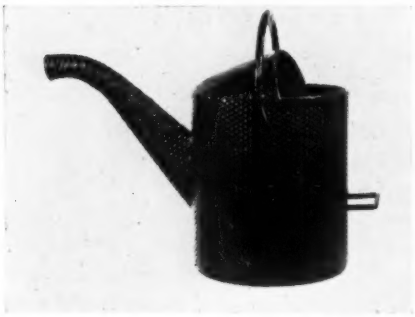
New Methods, Materials and Equipment for the Metal Finishing Industries

Container for Safe Pouring of Acids

Automotive Rubber Company, Inc., Dept. MF, 8601 Epworth Blvd., Detroit 4, Mich.

A new type unbreakable safety container for handling acids is announced by this firm.

Equipped with a long 14" spout with curved neck that rests securely on the edge of the tank, the design pro-



vides for safe pouring of acids where a reaction is expected.

Like other acid handling utensils in the Arco line, the new container is constructed of perforated steel with all seams welded. It is completely covered, inside and out and including handles, with 1/8" tough, seamless, semi-hard rubber. The inner and outer coatings are wedded through the perforations in the metal to assure permanent adhesion.

At present it is offered as standard in the five gallon size.

Improved Degreasing Solvent

G. S. Blakeslee & Co., Dept. MF, 19th St. & 52nd Ave., Chicago 50, Ill.

The above firm, a pioneer in the vapor degreasing field, announces a new degreasing solvent, improved by changing the stabilizers. These stabilizers are entirely new and radically different, it is claimed. They are used as true stabilizers, which prevent the breakdown of solvent and the formation of acids, and are not neutralizers of acids, according to the firm. These stabilizers are present at all times in all liquid and vapor phases of the solvent, it is claimed.

Because the true stabilizers are present at all times and do not react with fatty acids in oils, greases, buffing compounds, etc., it is not necessary to make frequent tests of the solvent, as was necessary in some instances in the past on extremely difficult degreasing operations.

A leaflet setting forth the details of this new Blacosolv is available.

Cyanide Bright Copper Plating Bath

The Wire Coating and Mfg. Co., Dept. MF, 395 E. 131 St., Cleveland, O.

The above firm has made available a cyanide bright copper plating bath for producing rapid, smooth deposits of copper that are easily buffed. The bath uses sodium salts, and operates at current densities up to 60 amps./ft.^{2} The addition agent is added to the bath periodically, about 5cc. per gallon per each 16 hours of plating operation. Agitation of the work is recommended, either by moving cathode rods or the motion in an automatic tank. Anodes may be bagged without causing polarization. According to the firm, the bath has the widest bright plating range of any of the commercial cyanide type baths now on the market, and operates successfully either with or without periodic reversal of current. Present cyanide baths may be converted easily to their new formula, it is said. Further details may be obtained by writing to the above address.

The firm also manufactures a bright dip for zinc plated parts, and addition agents for both zinc and cadmium plating baths to produce bright deposits.

Non-Silicated Cleaner

The Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

This new cleaner, Matawan No. 25W is a non-silicated soak or electro-cleaner especially suitable for applications where the presence of a silicate in the solution would interfere with subsequent processing. It is similar to Matawan No. 25, but with the addition of a wetting agent, according to the manufacturer.

Matawan No. 25-W may be used as a soak or electro-cleaner on steel, copper, brass, lead-base castings or die castings. Reverse electro-cleaning may be used on steel to secure smut-free surfaces. The concentration recommended is 3 to 8 oz./gal. The higher concentrations are recommended for steel.

Temperature range is 160° to 200°F. Immersion time for soak cleaning is 3 to 5 minutes. Immersion time for electro-cleaning is 30 sec. to 3 min.

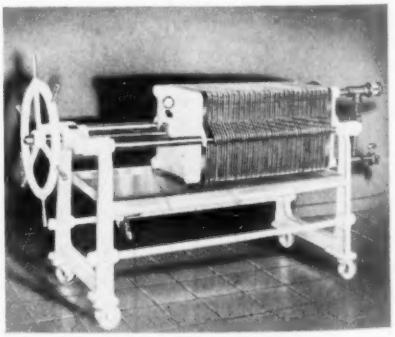
Current density for electro-cleaning is 20 to 50 amp./sq. ft. The higher range used for steel and copper; the lower for brass, lead-base coatings and die castings.

Hard Rubber Filter

The Ertel Engineering Corp., Dept. MF, 50 Front St., Kingston, N. Y.

Believed to be the first of its type available to industry, the purpose of this unit is to provide a complete circulatory passage of hard rubber and therefore prevent liquids from coming in contact with metals.

The filter is available in sizes from a 10 disk model having 2350 square



inches of filtering surface to a 100 disk model having 23,500 square inches of filtering surface. Sheet size is identical to that used in similar bronze or stainless steel filters—16" x 16" square.

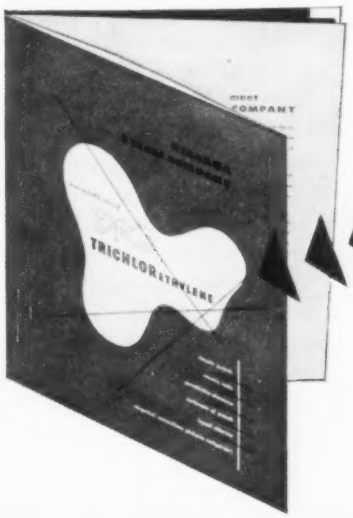
Filtration capacities, based on viscosity of water and filter sheet density, range from 5 to 50 g.p.m.

Introducing
NIAGARA ALKALI COMPANY

a new and dependable source of supply for TRICHLORethylene

Niagara Alkali Company, widely recognized as one of America's pioneer chemical producers, has now entered into the production of TRICHLORethylene. You are thus assured of a new and highly dependable source of supply for this important degreasing and metal cleaning agent.

NIALK TRICHLORethylene is produced in a new plant recently completed at Niagara Falls, N. Y. This new plant, which readily permits increased production facilities, is completely modern in every respect and utilizes control equipment that will satisfy the most exacting demands for a product of high quality and superior stability.



all you want to know

about NIALK TRICHLORethylene and the company that produces it is contained in a new booklet recently issued by Niagara. A copy will be sent to you immediately on receipt of this coupon:

Niagara Alkali Company, Dept. B,
60 East 42nd Street, New York 17, N. Y.

Gentlemen: Please send me a copy of your booklet on NIALK TRICHLORethylene.

Name_____

Position_____

Firm_____

Street_____

City_____ State_____

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Standard units are furnished with ball bearing type swivel casters. Can also be had with rubber tired wheels.

As a further safeguard against metallic pickup, this filter can be supplied with a pump which is made of unbreakable plastic and has a stainless steel drive shaft.

Roto-Clone Dust Collector

American Air Filter Co., Inc., Dept. MF, 215 Central Ave., Louisville, Ky.

The Type N Roto-Clone, used for the collection and control of dust generated in manufacturing and process operations, has been re-designed to permit wider application and improved performance. The Type N Roto-Clone is a hydrostatic precipitator that cleans the air by the combined action of centrifugal force and a thorough inter-mixing of water and dust-laden air, re-using the water without recirculation pumps or spray nozzles.

The new design with capacities thru 48,000 cfm maintains a lower pressure drop with the same cleaning efficiency and water recirculation rate and can be operated from 50% to 120% of its nominal rating without affecting its collecting efficiency, it is claimed. All sizes are available in either manual clean-out, sludge ejector or hopper bottom arrangement. Bulletin No. 277-A issued free upon request.

Acid Hood Protects Against Acid Splashes

Mine Safety Appliances, Dept. MF, Pittsburgh 8, Pa.

Lightweight, comfortable protection against acids, caustics, and other cor-

rosive chemicals is provided by the new M.S.A. Chemgard Acid Hood, described in Bulletin No. CF-24.

Made of flexible vinyl plastic with a sturdy inner headframe and clear, replaceable vinyl plastic lens, the M.S.A. Chemgard Hood is designed to combine safety and comfort for workers near acid lines, storage and pickling tanks, plating solutions, etc. The Chemgard Hood is electronically seamed and is attached by covered snap fasteners to a white-coated vulcanized fiber headgear. The headgear is easily adjustable to any headsize, is equipped with chin rest, and is pivoted so that the entire assembly may be swung up over the head.

Natural ventilation is provided by baffled air vents at either side of the Plastic Hood. If required, additional air may be introduced by a compressed air line attached to a fitting at the back of the hood. The vinyl bib section snaps securely at each side, providing comfortable fit around waist and under arms.

Sequestrant for Solutions Containing Calcium and Iron

Bersworth Chemical Co., Dept. MF, Framingham, Mass.

Bersworth chemists have developed a new sequestering agent called Versene Fe-3. This is particularly effective in sequestering the trivalent iron that often exists as a chemical contaminant in solutions, it is claimed.

As an example of the sequestering action of the new product, 10 cc of Versene F-3 sequesters 167 mg. of ferric iron as well as 158 mg. of calcium at pH of 7. The sequestering power

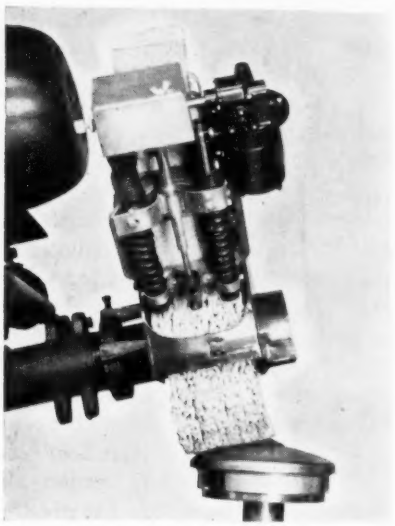
varies with the pH of the solution.

Trivalent iron in water and other aqueous solutions has always caused trouble in the preparation of soaps, fats, oils, emulsions, sanitizing agents, drugs, food products, textiles and metal processing. Until the discovery of Versene Fe-3, there has never been any good sequestering or chelating agent capable of overcoming it, according to the firm.

Buffing Compound Applicator

George L. Nankervis Co., Dept. MF, 5442 Second Blvd., Detroit, Mich.

Recently announced by the above firm is a completely automatic appli-



cator for automatic buffing machines to apply compounds to the buffs. It can be installed at any angle on any type of automatic, and has an intermittent feed control operating at 14 strokes per minute, with variable stroke adjustment. All operating parts of these applicators are covered to protect them against dust and buffing lint and compounds. A feature of this applicator is the quick-acting clamp that permits easy and rapid insertion of new bars of compound. The clamp will handle a wide range of bar sizes, including round bars. The light weight (22 lbs.) of the entire unit allows it to follow floating heads readily.

Anti-Tarnish Treatment for Silver and Other Metals

Abbey Materials Corp., Dept. MF, 208 E. 6th St., New York 3, N. Y.

Recently announced by this firm is a new electrochemical treatment for silver and silverplated articles, as well as gold, copper and copper alloys.

Treatment of parts in the Notarn process produces a completely invisible, colorless, and adherent coating that materially increases resistance to tarnishing and sulfide discoloration, according to the firm. Material is supplied in the form of a concentrate which is diluted 2-1 for use with water. Maintenance is easy, it is claimed, gravity readings being all that is required, with additions of concentrate to maintain correct bath conditions. The parts being treated are made cathodic at 2-3 volts; the film can be readily removed without damage to the parts or coating, it is claimed, by a simple immersion in dilute acid. Operation of the bath is not critical, and the work may be handled in baskets or trays if desired, according to the announcement. Further details may be obtained by writing to the above address.

Multi-Barrel Tumbler for Mass-Finishing

Hungerford Corp., Dept. MF, Big Flats, N. Y.

An entirely new type of deburring and polishing machine, designated as a Multi-Barrel Tumbler, for mass-finishing of metal and plastic products, is announced by this firm. With this equipment, up to fifteen different items can be handled at the same time, without mixing, and each can be tumbled in the manner best suited to its requirements. The variables include wet and dry tumbling; wide range of

speeds: rotary, centrifugal and end-to-end actions, and combinations of these actions. Thus, all degrees of contact and impact can be obtained, and delicate parts which heretofore required deburring and polishing by hand can now be machine-processed without danger of deformation, it is claimed.

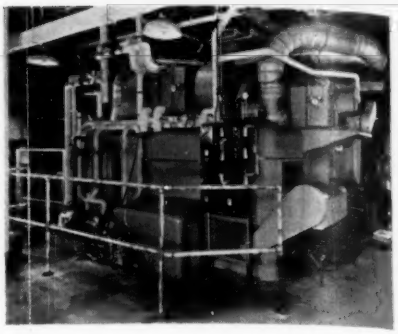
A circular mounting plate, with multiple perforations at center and six distances from center for attachment of the barrels, is rotated at a fixed speed. The barrels, of numerous lengths and diameters, are of round, hexagonal, cloverleaf, or special cross-section, and can be furnished with or without Neoprene lining. 73 standard units are available. They are mounted at right or other angle to the plate, as an added factor in providing virtually infinite selection in severity of action.

Center mounting produces a mild rotary action, and selective distances from the center add centrifugal action in desired degree, according to increasing periphery speeds. The angle mounting introduces end-to-end action, as well as rotary and centrifugal actions. Further details and specifications on the standard barrels and mountings are contained in a 4-page folder, available on request.

Combination Drum and Belt Washing Machine

Cincinnati Cleaning & Finishing Machinery Co., Dept. MF, Hecla Street, Ironton, O.

The combination drum and belt type washing machine shown above is designed for cleaning miscellaneous parts as well as the tote boxes used to carry the parts.



In this compact and finished machine, parts are dumped onto the hopper or loaded onto the belt, cleaned and discharged at the opposite end. Tote boxes are turned upside down and washed on the belt and discharged at the same end as are the parts. Extras can be provided for this machine so that parts and tote boxes can return to loading point for one-man operation.

This machine has been installed in many large industrial plants.

Cincinnati builds all types of washing machines in addition to the above standard design.

Heavy Duty Scotch Tape

Minnesota Mining & Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A second "Scotch" brand filament tape for heavy duty packaging was made nationally available in April by the above firm.

Designed with an acetate film backing, instead of paper, the new tape is waterproof, and is thinner than the paper-backed filament tape, making it easier to handle and enabling packages

banded with it to slide freely, it is claimed.

Caliper of the acetate film tape is 7-9 mils as compared to 13-15 mils for the paper backed tape. Both tapes have a tensile strength of 180 pounds per inch of width, and a tear resistance greater than the 1600 gram-centimeters

that can be measured on the ASTM-approved Elmendorf Tear Tester, according to the firm.

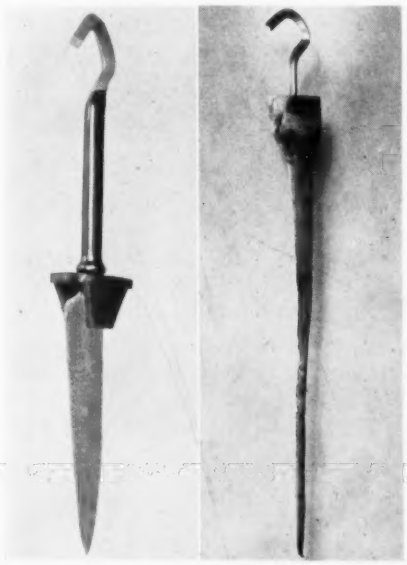
The tape needs no application equipment. It is designed for packaging metal pipes, rods, sheets and coils by being wrapped once around the load and back on itself. Its pressure-sensitive adhesive grips immediately on contact, it is claimed.

Colors available are black and transparent for the acetate film tape, and tan-white for the paper-backed product.

Insulated Anode Hook

Udylite Corp., Dept. MF, 1651 *E. Grand Blvd., Detroit* 11, *Mich.*

A new type plating hook for eliptical anodes, which cuts anode scrap as much as 50%, has been announced by the above firm.



Left—New hook, showing uniform solution of anode. Right—Old method. Note long spine which must be discarded.

This reduction in scrap is possible because this new hook allows the entire anode to be completely immersed in the plating solution. In the past, several inches of the top of the anode were kept out of the solution to protect the hook from being eaten away. This top part of the anode was usually discarded as scrap. In actual tests of this new hook, many times greater savings in scrap were experienced, it is claimed, since the weight of eliptical anode metal is approximately one pound to the inch and now the complete anode can be immersed.

The firm also points out that this new anode hook is usable over and over, since it withstands all plating solutions and temperatures. By being able to immerse the entire anode, it means that shorter anodes can be used in many cases.

The practicability of this new hook centers around a specially designed cap of Neoprene which fits over the top of the eliptical anode. It has shoulder-like projections which protect the center section of the anode where the threads of the hook fasten into the anode proper. When the hook is turned tightly into the anode, the pressure of the hook against the cap seals the anode top to the hook and does not permit plating solutions to seep into the section where the hook threads enter the anode.

The new hook comes in two sizes, 6 and 8 inches, and fits all anode rods up to and including one-and-one-half inches in diameter.

Rust-Proof Wrapping for Metal Products

Shell Development Co., Dept. MF, 50 *West* 50*th St., New York* 20, *N. Y.*

It is now possible to rust-proof tools, engine parts, fine instruments, and other metal articles without greasing or sealing airtight, simply by wrapping them loosely in a chemically treated paper, according to *Dr. M. E. Spaght,* president of Shell Development Company. Shell Development is the research affiliate of Shell Oil Company.

Key to the new method of preventing rust is a special chemical developed

by Shell and marketed under the trademark VPI, for Vapor Phase Inhibitor. Ordinary kraft paper is coated on one side with VPI. Then, after a metal article has been wrapped in this paper, the chemical slowly vaporizes inside the package, neutralizing the corrosive action of moisture in the air.

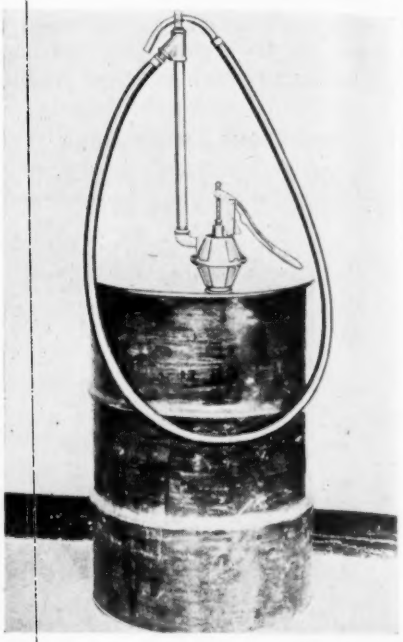
Although VPI paper, now being produced by three manufacturers under license from the Shell Development Company, is for sale only in commercial quantities, it may be used by the ultimate purchaser to re-wrap the article and thus protect it when not in use. Several types of prefabricated packages may be made with VPI-coated stock, such as corrugated cartons, envelopes, bags, or pre-formed VPI paper sheaths tailored to fit the article to be protected.

Depending on the tightness of the wrapping, VPI paper provides complete surface protection for periods ranging from a month to more than five years, even under severe conditions of temperature and humidity, it is claimed. For average use, in which protection is needed for only one or two years, simple fold closures of the paper, secured by string or gummed tape, are adequate, but for long term protection, tighter closure with foil wrapping is recommended, but the package need not be hermetically sealed, according to the firm.

Drum Pump

General Scientific Equipment Co., Dept. MF, 2700 W. Huntingdon St., Philadelphia 32, Pa.

A special nylon cord, neoprene coated diaphragm which is very strong and stands up under gasoline oils, is the outstanding feature in the new No. 700-B pump.



The Hose is approximately 8 feet O.A. and has a static wire to lessen fire hazard. Special tube is provided for motor oils.

For underground and skid tanks. Pump is ideal for underground work, as it has very high suction and is self-priming. Automatic drainback feature permits draining of hose and pump back into tank. Lower casting is threaded for 1½" and 2" pipe. Will pump approximately 7 gallons per minute.

Each pump is fitted with an adjustable suction pipe and hose.

Rigidized Metal

Rigidized Metals Corporation, Dept. MF, Buffalo, N. Y.

Rigidized Metal tubing is now available to furniture and display equipment manufacturers, according to the above firm. Rigidized tubing is of welded carbon steel, and is produced and sold by Standard Tube Co., Detroit, Mich.

The textured finish of the Rigidized Metal tubing hides surface scratches and is said to be less expensive to plate because it does not require polishing.

Stronger than plain metal sheet, Rigidized Metal resists marring during fabrication and makes possible the use of lighter metal gauges, thereby effecting further cost savings, it is claimed.

Rigidized Metal patterns produce a tubing which is more attractive in appearance than plain metal, and one which provides a longer service life, free from scratches and other evidence of wear, according to the firm.

Business Items

O'Brien to Head New Troxide Department for MacDermid

MacDermid, Incorporated, of *Waterbury, Conn.*, has announced the purchase of the manufacturing and distribution rights of Troxide Compounds

Thomas F. O'Brien

from the *Waverly Petroleum Products Co.*, of Philadelphia. Simultaneously, MacDermid announces that *Thomas F. O'Brien*, who formerly headed the Industrial Chemical Division of Waverly, will take charge of a newly formed department to develop and promote Troxide and allied acid salt compounds for metal finishing and to assist in the development of new MacDermid products to be announced shortly. Mr. O'Brien, a metallurgical engineer, was formerly associated with the Philco Corporation and General Motors Corporation, in addition to acting as consulting engineer to several large corporations.

Appointments Announced by Atlas Mineral Products

Mr. James H. Fry has resigned his position with the American Sugar Refining Company to accept a position as research chemist with *The Atlas Mineral Products Company, Mertztown, Pa.* Mr. Fry was formerly associated with Bowman Gum. Inc., Bakelite Corporation, E. I. du Pont de Nemours & Co. and Celanese Corporation.

Mr. F. C. Card has resigned as assistant production manager of the Wannamaker Chemical Company to accept an appointment as district manager of materials of chemical construction sales for the company in the eastern New York and New England territory.

Joseph Dahle, formerly research director of Symco Chemical Corporation and Aspinook Corporation, has been appointed director of research.

C. P. Stocke Celebrates 40th Anniversary with E. F. Houghton & Co.

C. P. Stocke recently celebrated his 40th anniversary with *E. F. Houghton & Co.*, manufacturer of industrial oils, chemicals and leathers. Stocke has been assistant secretary of Houghton since 1919.

In April 1909 he joined the company

as assistant to *A. E. Carpenter*, president of Houghton, who at that time was sales manager.

During his early years with the company, Stocke studied at Wharton School of Business Administration, University of Pennsylvania. He soon was advanced to chief correspondent of sales. Shortly afterward Stocke was made business secretary to *Charles E. Carpenter*, then president.

As assistant secretary of the company his duties include recording the minutes at director's meetings, acting as special assistant to *D. J. Richards*, vice president—sales, on correspondence, as well as filing all reports, communications, patents and trade marks belonging to the company.

Allen D. Russell Named Michigan Chrome Representative

Allen D. Russell has been named sales representative for the *Michigan Chrome and Chemical Co.*, covering the states of Ohio, Pennsylvania, and New York, as well as Canada. He succeeds *Frank Jones*, who was recently transferred to the eastern states.

Mr. Russell is well qualified to handle the technical details involved in the sale of Michigan Chrome and Chemical Company's various products. He attended the Chemical Engineering School at Wayne University, majoring in Metallurgy. Upon leaving Wayne University, he worked with the Timkin Detroit Axle Company where he was in charge of the heat treat and plating departments. Mr. Russell also spent

Allen D. Russell

several years as a project engineer with the Kaiser-Frazer Corporation in the Metallurgical Laboratory.

C. D. Jones Becomes Purchasing Agent for Diamond Alkali

Appointment of *Chester D. Jones, Jr.*, as purchasing agent of Diamond Alkali Company was announced here recently by *W. E. Bittner*, director of purchases.

In assuming his new post, Jones returns to Diamond's general headquarters at Cleveland from Houston, Tex., where he has served "on leave" since 1946 as plant purchasing agent during the construction and initial production period of the company's recently completed $14,500,000 electrolytic chlorine-caustic soda plant.

Three other departmental promotions were announced simultaneously with Jones' appointment:

W. C. Logan, who joined the department in 1925, moves up as assistant purchasing agent.

W. C. Mahan, also a 24-year Diamond man, who has been in purchasing since 1937, similarly advances to assistant purchasing agent.

P. P. Eppinger, succeeds Jones as plant purchasing agent at Houston.

Electric Products Co. Appoints E. Lowe McIntyre, Jr.

The Electric Products Co. of Cleveland, Ohio, recently appointed *E. Lowe McIntyre, Jr.* as Assistant Sales Manager in charge of New Market Developments. Mr. McIntyre will be located at Headquarters in Cleveland.

E. Lowe McIntyre, Jr.

He brings to his new position a broad and well-balanced experience consisting of 9 years industrial selling with *Westinghouse Electric Corporation* and 5 years with *Jack & Heintz Precision Industries, Inc.* doing staff work and as sales manager of the Electric Motor Division. Educated as an electrical engineer, Lowe McIntyre graduated from the University of Pittsburgh in 1934.

This appointment is another step in the long-range plan of The Electric Products Co. to acquire qualified personnel with extensive industrial sales experience to further develop their nation-wide sales program.

Improved Cleaners Subject of Pennsalt Sales Meetings

New manufacturing techniques have virtually eliminated dusting and segregation in the Pennsalt line of cleaners, salesmen for the Special Chemicals Division of *Pennsylvania Salt Mfg. Co.* were told at recent meetings here and in Chicago.

These techniques, and the results accomplished through them were thoroughly explained to men attending the Mid-Western and Eastern Regional sales meetings by *Joseph J. Duffy, Jr.*, Manager of Sales for the Division.

Both meetings featured lively discussions by a number of Division executives, including *A. H. Clem*, Field Sales Supervisor; *Philip C. Staples* and *Robert R. Pierce*, Product Supervisors; *V. A. Curll*, Technical Advisor, and *Bryce Gray, Jr.*, Assistant Advertising Manager.

Diversey Adds to Sales Staff

The Metal Industries Department of *The Diversey Corporation, Chicago, Ill.*, has added five men to its staff of field service engineers. Before entering their territories, these service representatives were required to complete an extensive course of technical training covering all phases of surface preparation and metal finishing. Left to right: *A. J. Crouch, P. M. Saxman, W. H. Murphy, E. F. Manning,* and *E. V. Hall.*

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys

The Subcommittee on Spray Test is recommending minor changes in the *Method of Salt Spray (Fog) Testing (B 117)* to improve the control of testing conditions and to make the method applicable for painted panels. The subcommittee is making studies of the acetic acid—salt spray test for plated die-castings and on the effect of various concentrations of salt solution.

Detroit Plating Firm Under New Management

The *Detroit Plating Industries* has announced a change in ownership effective April 1, 1949. *Louis S. Morse, Jr.*, has acquired the outstanding shares of stock, and will become the new president and general manager.

H. A. Molt has resigned as the active head of the corporation; *P. H. Henning* will remain for an indefinite period as production manager and assistant to the president. Except for the above, no other changes are contemplated.

Mr. Morse was formerly associated with the firm of Roller and Golibart, Inc., manufacturers' agents. During the war, he served as a Lieutenant Commander, USNR, and was the factory planning officer at the Naval Torpedo Station, Newport, R. I. Prior to the war, he was connected with the York Ice Machinery Corporation as sales engineer in the Detroit territory.

Gold Plated Typewriter Introduced As De-Luxe Gift Item

The *Royal Typewriter Co.*, world's largest manufacturer of typewriters, recently introduced a special golden, gift-model portable typewriter, known as the Golden Royal. It is the finest regular model Royal portable, the Royal Quiet DeLuxe, finished in 18-kt. gold and glistening black, and will be supplied in a custom-made, airplane luggage-type case.

The machine, most of which is hand made, is a magnificent combination of gold and black. The sides and all of the fittings are a brilliantly-polished gold. The top is black enamel. The keys are enclosed by a thin strip of gold. The owner's name or initials

can be inscribed on a gold name plate. The case is covered by a rich, brown fabric with leather binding.

It is believed that the Golden Royal will be purchased for gifts for business executives, statesmen and public servants being honored on specific occasions. The first Golden Royal was presented recently to General *George C. Marshall*, former Army Chief of Staff and Secretary of State, by the Overseas Press Club of America, at their recent annual banquet at the Waldorf-Astoria Hotel.

The Overseas Press Club wanted to honor General Marshall with a unique and outstanding gift, and selected the Golden Royal as most appropriate.

In the photo above Mr. Marshall is receiving his gold plated portable typewriter from Mr. W. W. Chaplin, President of the Overseas Press Club.

Healey Joins Antara Products

William H. Healey, formerly associated with *Arthur D. Little, Inc.*, has been appointed supervisor of market research for *Antara Products*, a division of *General Aniline & Film Corp.*, it was announced recently by *Harold G. Shelton*, General Manager of the division.

Mr. Healey, who was a private consultant before his association with Arthur D. Little, Inc., will be concerned chiefly with the division's surface active agents and acetylene chemicals.

Amer-Craft Products Launches Buffing Research Project

Amer-Craft Products, Not Inc., 1024 *South California Ave., Chicago, Ill.*, has launched a large scale research project which, it is hoped, will permit the selection of buffs according to laboratory tested formulae.

Preliminary studies have revealed that in most instances the selection of buffs has been based upon trial and error methods, little regard being accorded the physical properties of the cotton buff fabric and the metal to which it is applied. This research is intended to correlate the texture, grade and count of the cotton material with the topographical and metallurgical factors of the metal product to be finished, and, finally, to spell out such correlation in simple but definite terms and charts so that the metal finisher can, without guesswork, determine the most efficient buff for a given operation.

To that end, *Mr. Louis M. Shapera*, general manager of Amer-Craft Products, announced that studies are going forward in a modern metallurgical laboratory, fully equipped to lend itself to the project. At the same time, plans are being made for the acquisition of experimental finishing equipment for the purpose of developing the data under normal polishing-room operating conditions.

New Trade Name for Detrex Cleaning Materials

Effective immediately, the *Detrex Corporation, Detroit 32, Mich.*, is extending the use of their registered trade name "Detrex" for identification of alkali cleaning compounds, strippers, emulsion cleaners, and wet spray booth materials that they manufacture.

The trade name "Detrex" is followed by a number or letters to indicate the different materials to which it is applied. These identifying numbers or letters are not being changed.

The registered trade name "Triad"

is now being reserved exclusively for use in identifying Detrex Corporation's chlorinated hydrocarbon solvents for vapor degreasing and oil extraction.

Osborn Announces Sales Personnel Changes

New territorial assignments, made necessary by retirement and other personnel changes within its nationwide sales organizations, are announced by *Robert Wier, Jr.*, General Sales Manager of the Brush Division of *The Osborn Manufacturing Co.*, of *Cleveland, Ohio.*

P. A. Malling, formerly assigned to the New Jersey area, has been transferred to Los Angeles from where he will cover the West Coast. Mr. Malling will have headquarter offices at 448 *South Hill Street* in *Los Angeles* and at 1355 *Market Street in San Francisco.*

John McGinnis

John McGinnis, formerly of Osborn's sales service department in its Cleveland headquarters, will cover the Cincinnati, Kentucky and Western Tennessee area.

Due to the retirement of *F. B. Atwood*, an Osborn veteran of more than 20 years' service, the Vermont and part of Massachusetts area he covered will now be included in the territories covered by *H. C. Donovan* and *G. B. Pecsok.*

Joseph Hammond has been transferred from the Eastern Pennsylvania territory to the New Jersey area formerly occupied by Mr. Malling.

E. M. Schoemmell, Jr., formerly of the company's Virginia and Maryland sales area, has been transferred to Eastern Pennsylvania.

L. F. Holfelder will move his sales headquarters from Cincinnati to the Virginia-Maryland area.

Robert Ruthenberg

Robert Ruthenberg has been transferred from the Chicago office to headquarters in Milwaukee to take over the Wisconsin territory formerly served by A. L. Nevers, who has resigned.

DuPont Announces Changes in Electrochemicals Dept.

Three personnel changes in the Technical Division of the Du Pont Company's Electrochemicals Department were announced today.

Dr. Paul R. Austin, an assistant director of the Chemical Department laboratory at Du Pont's Experimental Station, was appointed director of the

Electrochemicals Department's Technical Division.

Dr. Harold J. Barrett, chemical research manager at the Niagara Falls, N. Y., plant was named manager of field research with headquarters at Wilmington.

Dr. Campbell Robertson, manager of chemical research at the Perth Amboy, N. J. plant, was named chemical research manager at the Niagara Falls plant.

The appointments are effective May 1.

Dr. Earle A. Harding, who has been director of the Technical Division, and *Paul J. Carlisle,* who has been manager of field research, will retire from active service about the end of this year. Until that time they will serve as special assistants to their successors.

Mathieson Makes Executive Changes

Mathieson Chemical Corp. has made several changes in operating management due to the increase in the number

Dr. Carl F. Prutton

of plants resulting from recent acquisitions. *Dr. Carl F. Prutton* has been appointed vice president-director of operations of all the company's plants, and *Arthur T. Bennett,* vice president, was placed in charge of the eight plants acquired from Southern Acid and Sulphur Company. *R. B. Worthy* and *J. F. Newell* were named vice presidents.

Dr. Prutton, who joined Mathieson last year as director of research, will have charge of research and supervise operations of all the company's plants including those recently acquired. His

Arthur T. Bennett

headquarters will be in the Mathieson New York offices. Mr. Bennett will have his headquarters in Houston. Mr. Worthy will be in charge of the plants acquired from Standard Wholesale Phosphate and Acid Works as well as the Saltville, Va., plant, of which he has been manager. Mr. Newell remains at Lake Charles, La., where he has been in charge of the alkali and ammonia plants.

Student Groups Visits New Electroplating Laboratory

The advanced electrical class of the Henry Abbott Technical school, together with the electronics class of Danbury Teachers' college, were guests recently of the *Hanson-Van Winkle-*

Munning Company of Matawan, N. J.

The group visited the new laboratory where research in electroplating is done and other studies in electrochemistry are carried on. This laboratory, completed last year, is one of the best in the industry. Special exhibits and demonstrations had been arranged for the students and each department offered new attractions in electro-deposition techniques and processes.

After lunch in a nearby inn, the class returned for an inspection trip through the manufacturing plant of the company where electro-plating generators and related control equipment are built.

The trip was arranged through the courtesy of *George Hogaboom*, of New Britain, a consultant in electro-chemistry and formerly technical director of the Hanson-Van Winkle-Munning Company. *Robert E. Creamer*, of New Haven, sales representative for the company in Connecticut, accompanied the group.

Plating and Polishing Wage Survey

A survey of wage conditions in the finishing and plating shops of Chicago has been announced by the Chicago Electroplaters Institute. The report covers 34 job plating and polishing firms, 6 of which are organized and 28 of which are not organized. While the averages of individual occupations varied, both types of shop had exactly the same average hourly base

rate of $1.29 for all occupations. A partial list of the average wages for various occupations as disclosed by this survey follows:

	Base Rate per hr.
Plater Leadman	$1.58
Plater "A"	1.37
Platers helper	1.13
Wirer and racker	.95
Polisher-buffer "A"	1.76
Polisher-buffer "B"	1.43
Degreaser	1.17

Polishers working on a piece-work basis were earning about 20 cents above the average Base Rates given above.

Obituary

Irving Lewis Burrows, of Behr-Manning Corp., died at the Samaritan Hospital, Troy, N. Y., after a long illness. He was 62 years of age. Mr. Burrows was a native of Schenectady, N. Y.

For many years he was connected with Hammacher, Schlemmer of New York, and in 1922 he joined the Manning Abrasive Co. of Troy, which, in 1929, became the Behr-Manning Corp. For many years he was manager of the Equipment and Products Engineering Div. of the company, and in 1947 received Behr-Manning's highest award, a 25-year gold service emblem in recognition of loyal and faithful service to the company.

He was responsible for the introduction of many new mechanical operations employing sandpaper and abrasive cloth for grinding, sanding and polishing all kinds of materials. His outstanding accomplishment was in the stainless steel field, in which he introduced new machine methods of finishing and polishing that have been widely adopted by the industry.

Irving L. Burrows

Mr. Burrows is survived by his wife and 2 children.

Manufacturers' Literature

Polishing and Buffing Machines

Vanott Machine Corp., Dept. MF, 216 Colgate Ave., Buffalo 20, N. Y.

Two new bulletins just released by this firm describe their single spindle and 8 spindle semi-automatic polishing and buffing machines, and includes information on right-angle and variable angle attachments for special purposes. A feature of these new machines is the enclosing of all vital parts in a dust-proof guard to avoid abrasion by the materials used in the polishing operations. According to the manufacturer, these machines will handle round, square, triangular, rectangular, oval and other shapes of articles for polishing or buffing. Copies of these bulletins are available on request.

Precious Metal Plating

A. Robinson & Son, Dept. MF, 131 Canal St., New York 2, N. Y.

The latest edition of the popular booklet "Precious Metal Plating" has recently been issued by the above firm,

manufacturers of precious metal plating solutions and salts. Topics covered include Equipment Required, Heating Methods, Preliminary Cleaning, Electrocleaning, Pickling and Bright Dipping, Racking and Wiring, Rinsing and Drying, and the complete Gold and Rhodium Plating Cycles. The advantages of specially prepared solutions in maintaining uniformity of thickness and color are also discussed. Free copies of this booklet are available by writing to the above address.

Rectifier News

International Rectifier Corp., 6809 So. Victoria Ave., Los Angeles 43, Cal.

Publication of the first issue of the "Rectifier News" was recently announced by the above firm. This four-page periodical will feature technical articles, photographs, circuit diagrams, etc. concerning new developments in the field of dry-plate (especially selenium) rectifiers for converting A.C. to D.C. Regular subscription to this periodical is available to all qualified persons in the enginering profession without charge if requested on company stationery.

The first issue of the "Rectifier News" (identified as RN-349) features the following articles:

"The Voltage Doubler Circuit"
"Cathodic Protection of Underground Pipelines."
"What Is Selenium?"
"Dry Plate Rectifiers."

The International Rectifier Corp. is a manufacturer of high and low power selenium rectifiers capable of handling any D.C. power requirements from micro to kilowatts.

Abrasive Belt Machinery

The Standard Electrical Tool Co., Dept. MF, 2503 River Road, Cincinnati 4, O.

Bulletin 70 covering their complete line of abrasive belt machinery has just been published by this firm.

This literature describes bench and floor models with horizontal backstands, flexible horizontal - vertical backstands, individual wheel heads, various sizes of spring loaded and air cylinder backstands using from 6" to 20" diameter contact wheels, belt speeds as high as 9500 S.F.P.M., along with a variety of heavy duty polishers and grinders with work rests as required for heavy grinding and snagging with abrasive belts.

Bristol Publishes Industrial Waste Disposal Bulletin

The Bristol Company, Dept. MF, Waterbury 91, Conn.

The above firm announces the publication of Industry Data Bulletin 138 entitled, "Industrial Waste Disposal." The bulletin describes the application of the company's automatic pH Recording and Controlling instruments and recording flowmeters to industrial waste disposal operations. Photographs of the instruments and diagrams of several typical waste disposal applications are included. Copies are available without charge.

Sampler and File Holder

American Nickeloid Co., Dept. MF, Peru, Ill.

A handy index to a wide selection of

pre-plated metals is available in the new Nickeloid Metal "Sampler" and File Folder.

The die-cut Sampler, a four-page, letter-size folder, contains samples of metals finished in chrome, copper, nickel and brass—available on zinc, steel, copper, brass and aluminum base metals. In addition to actual samples in bright and satin finishes, striped and crimp designs, complete data is given on the sizes of sheets, coils and flat strips available.

Sheets, as listed in the data table, are offered in sizes up to 36" x 96", depending on type of plating and base. Coils, extremely adaptable for rapid production, come in widths ranging in size from 1/8" to 24". Flat strips are listed as available in strips 3/8" or wider, up to 96" in length. Further information gives gauges, tempers, finishes, properties, and a description of special protective coatings and tints currently available.

Bright Dip for Brass and Copper

Technic Inc., Dept. MF, 39 Snow St., Providence, R. I.

A bulletin recently issued by the above firm lists the uses and advantages of their new bright dipping salt for brass and copper. The material is used in a concentration of 4 oz./gal., the final solution costing about 40 cents per gallon, according to the firm. It produces a bright, smooth satin finish, it is claimed, and is non-fuming and non-irritating.

Training Technical Servicemen

With industry today relying more and more on the recommendations of the engineers and specially trained representatives of its material and equipment suppliers as dependable sources of technical assistance, it is interesting to read about the comprehensive training course with which one manufacturer equips his field service specialists for this work.

Such a course is graphically described in a special 40th anniversary issue of *Oakite News Service*, house organ of *Oakite Products, Inc.*, long-time suppliers of specialized industrial cleaning materials. A feature section of this issue shows how new field service representatives are trained in the latest technical developments and techniques of industrial cleaning and related operations. This is done by having the camera follow two trainees through the company's chemical research and service laboratories, into special lecture sessions by its field engineers, and through the many other phases of the course. Finally, an unusual photograph taken at the completion of the course shows a new service representative surrounded by some 750 pounds of demonstrating and testing equipment, technical literature and other service aids, ready to assume his new duties in providing industrial plants with the all-around technical advisory service demanded by today's complex cleaning and associated problems.

Readers interested in obtaining free copies of the special issue of Oakite News Service in which this training course is described, should address *Oakite Products, Inc., 118 Thames St., New York 6, N. Y.*

Waste Treatment

Infilco Inc., Dept. MF, 325 W. 25th Place, Chicago 16, Ill.

The above firm manufacturers of water conditioning and waste treating equipment, announces the publication of a new bulletin, "Waste Treatment to Comply with Stream Pollution Control Regulations."

It is intended primarily to inform the industrial plant executive or municipal engineer, who is charged with responsibility for pollution control,

of the latest important methods of waste treatment.

The bulletin describes briefly the general problems involved and then discusses the principal treatment methods. Actual case studies are reported.

Copies of Bulletin 70 are available upon request.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Bridgeport Branch

Spring Dinner Dance

Once again the Bridgeport Branch of the American Electroplaters' Society is coming up with a good time for its members and friends. The big event is the Spring Dinner Dance which will be held Saturday, May 28th 1949 at 7:00 P.M. in the Main Ballroom of the Stratfield Hotel.

The Committee has worked hard on the preliminary arrangements to make it pleasant and entertaining, and from all indications this is going to be a very successful affair. There will be six awards for the ladies, and four awards for the men, in addition to a fine floor show, arranged by *Ray Goral*, and dinner to delight an epicure's palate arranged by the connoisseur of fine foods, *Wm. Ehrencrona*, Chairman of the Committee. Dancing will be to the music of Al. Christie's Orchestra.

The attendance to this event is limited to 150 persons, so reservations should be made as soon as possible with *Joseph G. Sterling*, 134 *Colony Street, Bridgeport* 8, *Conn.* Tickets are $4.00 per person (tax included).

Baltimore-Washington Branch

The regular monthly meeting of the Baltimore-Washington Branch was held April 12, with an attendance of about 50. After a short business session, *Dr. William Blum* introduced *Mr. William M. Phillips*, Head of the Electrochemistry Department of the General Motors Research Laboratories. Mr. Phillips gave a very stimulating talk on the instruments used for the control of electroplating. He described the use of such instruments as the electron microscope, Brush analyzer, Hull cell, spectrograph, spectrophotometer,

Magne-gage, and spiral contractometer, giving typical measurements made by them. He also talked of x-ray diffraction, hardness measurements, and other metallurgical measurements. Performance tests were also discussed. After the talk, there were numerous questions from the floor indicating a lively interest in the subject.

The following officers were elected to head the Branch for the coming year:

President—*Fielding Ogburn*, National Bureau of Standards.

Vice-President—*Raymond Stricklen*, Jr., Allied Research Products, Inc.

Secretary—*Vernon A. Lamb*, National Bureau of Standards.

Treasurer—*George M. Keller*, Naval Research Laboratory.

Librarian—*Walter A. Olson*, Bureau of Engraving and Printing.

Toronto Branch

The Annual Technical Session of the Toronto Branch will be held at Niagara Falls, Ontario, May 28. Hotel General Brock will be the centre of activities. Technical Sessions will be held in the afternoon, followed by Dinner at 6.30 P.M. An informal Dance will be held in the evening in the Main Ball Room. All persons interested in electrodeposition of metals are invited to attend.

Detroit Branch Stag Day

The Detroit Branch of the American Electroplaters Society is planning to hold their Second Annual Stag Day at the *Forest Lake Country Club* near Pontiac, Michigan on Saturday, July 30, 1949.

All of those who attended last year's party will not want to miss this gala occasion. For the benefit of those who have never attended, the same high standards of perfection are attained in this party as are reached at the Annual Meeting in December.

Golf will be available for those who want to play; also horseshoes and softball. Free beer will be on tap and a big dinner in the evening. To top off this big party, there will be lots of excellent door prizes.

Walter Pinner is acting as General Chairman, heading up a very capable Committee who plan to make this one of the biggest events of the year sponsored by the Detroit Branch.

Twin City Branch

The Twin City Branch of the American Electroplaters' Society met on Monday, April 4th, 1949, following dinner at the Lodge Room of the Covered Wagon in Minneapolis. There were 34 persons present.

Newly-elected President *Cliff A. Bowman* of Minneapolis Honeywell introduced the guests, who were *Cliff Nelson*, of Josten's, Owatonna, Minn.; *Don Kaplan*, of Owatonna Tool Company, Owatonna, Minn.; and *Bob Hawkins*, of Hawkins Chemical Company, Minneapolis.

The new Committee appointments were announced and the various Chairmen were acknowledged.

Ben Rosenthal of the Wyandotte Chemical Company, Branch Display Chairman, gave a report on the display for the coming Convention in Milwaukee. Due to the fact that we have won a prize for the past two years, he stated that we should look for a bigger and better display for this exposition.

Branch Secretary-Treasurer *Bob Buckley*, of Industrial Chemical and Equipment, passed out the Annual Financial Report and discussed same. It was definitely agreed that we need more members.

Following the business meeting, Branch Librarian *Wray Schorr* (now 2nd Vice-President) introduced Mr. *C. R. Fischrupp*, of Western Electric Co. (Hawthorne Plant), who spoke on "Copper, Nickel and Chromium Plating." Mr. Fischrupp's talk was very interesting and informative.

Chicago Branch

The March meeting of the Chicago Branch was held at the Atlantic Hotel on March 11th. About 85 members and guests attended.

The speaker for the evening was *Mr. Louis Shustig* of the E. I. du Pont Co., who gave an excellent talk, accompanied by slides, on the du Pont bright copper plating solution. His talk was mainly based on the advantages found after considerable experience using the new-type canvas diaphragm partitions in copper plating solutions. His slides illustrated that there are several ways in which to place the canvas diaphragms and still obtain considerable advantage in smoother plates. If the cost of installing diaphragms on a compartment basis was prohibitive, a curtain type diaphragm could be used. This is a canvas partition in front of the anodes extending below the depth of the normal plating racks. This method would result in about a 90% improvement, whereas the compartment type diaphragms used in conjunction with continuous filtration results in extremely smooth deposits. Mr. Shustig pointed out that if day to day operation demands smooth desposits, the use of canvas diaphragms will easily pay for itself in a relatively short time.

Mr. Shustig's speech was followed by a lively open discussion on copper plating. Some comparisons were made between the conventional acid type copper bath and numerous bright copper plating baths now in use.

This meeting was preceded by a business meeting attended by officers and various committees.

April Meeting

The April meeting of the Chicago Branch was held at the Atlantic Hotel

on April 8th, with 88 members and guests attending.

The speaker for the evening was *Mr. Fischrupp,* of Western Electric Co., who spoke on "Industrial Methods of Automatic Plating." His talk was extremely interesting and profitable inasmuch as it was accompanied by slides and a very practical discussion.

Mr. Fischrupp also showed graphs and charts on their method of maintaining accurate control of their plating thicknesses and adhesions. His chart showed periodical samples taken from production lots and immediately sent for laboratory mounting and thickness checking. These charts were maintained on an hour-to-hour basis and were kept on a large chart showing daily production percentages of acceptable plated work.

Another application used by Western Electric for a combination wear and corrosion-resistant finish was the application of 20 minutes of dull white nickel plate, followed by an 18 minute hard chromium plate. This part was a contact lever and is reported to perform satisfactorily after 5,000,000 contacts.

Mr. Fischrupp's talk was followed by the usual open question session in which some problems were quite lively discussed.

The April meeting also included election of officers for the coming year. The following people were elected:

President—*Mr. Paul Glab*—Northwestern Plating Wks.

1st Vice President — *Mr. Joseph Boudreau*—Plastic Printing Plates, Inc.

2nd Vice President—*Mr. Arthur Bartmann*—Bell & Howell, Inc.

Secretary-Treasurer — *Mr. J. M. Andrus,* Croname, Inc.

Librarian—*Dr. J. H. Monaweck*—Illinois Watch Case Co.

BOARD OF MANAGERS

Mr. Marion Longfield—Pheoll, Inc., Chairman.

Mr. Leroy V. Zinn—Stiles Bros. Plating Co.

Mr. Les Kocour—Kocour Co.

Delegates—Messrs. *Longfield, Kelly* and *Andrus.*

Alternates — Messrs. *Monaweck, Hazucha,* and *Gilbertson.*

Los Angeles Branch

Dr. Carl A. Zapffe, consulting metallurgist of Baltimore, Maryland, was the principal speaker at the April meeting of the Los Angeles Branch. He presented a talk, illustrated by slides, on the aspects of hydrogen in electroplating.

Dr. Zapffe's talk dealt mainly with hydrogen embrittlement, the relation of hydrogen in peeling, blistering and porosity. He also discussed the mechanism whereby hydrogen enters the

base metal and the plated deposit, and its effect.

At the business session, *Allie Sulzinger*, newly elected president, and the other new officers elected at the March meeting were installed, with *Earl Coffin* serving as installation director.

Miss Florence E. English, chemist of the Modern Plating Company, Los Angeles, was inducted into membership as the first woman member of the branch. Another new member inducted was *Phillip Greathead*, president of the Square Deal Machine Co., South Gate, Calif.

Howard Woodward, general chairman of the committee which handled the direction of the branch's annual educational session and the preparation of the 1949 Handbook, reported that a profit of approximately $1000 had been derived from the booklet. Upon motion by *Richard Wooley*, the amount was set aside as the nucleus of a special expense fund for the 1951 AES convention in Los Angeles.

It was also reported that a certified copy of articles of incorporation had been recently filed with the Los Angeles County clerk, and that the branch was now officially incorporated under the name of Los Angeles Branch of the A.E.S., Inc.

Guests at the April 13 meeting included *Edward Delameter, Clifford Pierce, D. W. Vance, Joseph Vanderhager, J. W. Hanlon* of the Chicago Branch, *Florence English, H. E. Wells, R. C. Mayvench, Phillip Greathead, Ruth Bankhead, Pauleen Tushland, Donald Shaw, Charles Scheiss* and *Louis Veenker*.

The Los Angeles Branch has issued a 1949 Handbook in which are combined the properties of a plating technical volume, a membership roster, and a directory of plating establishments on the Pacific Coast.

Printed on book paper, the handsome 1949 volume contains 146 pages, approximately one-third more than the last such book published by the branch in 1945.

The booklet is not intended to be a comprehensive technical publication, but to serve as a handy reference for the man who is responsible for production in the shop. The technical content consists of a series of articles by branch members on various electroplating processes, solutions, plating on different materials, and technical data sheets.

All members of Los Angeles Branch of the AES are listed therein by name and address. The list of Pacific Coast plating establishments contains the names and addresses of 344 shops in California, Washington, Oregon, Nevada, Arizona, Idaho and British Columbia.

Howard Woodward was general chairman of the committee which prepared the Handbook. Assisting Editor *Earl Coffin* were Associate Editor *Robert H. Longacre* and Technical Editor *Dean D. Williams*. *R. J. Wooley* was chairman of the business committee for the Handbook. The booklet was distributed free at the branch's Annual Educational Session on March 19.

Concentrating on all-western talent for the presentation of technical papers, the Los Angeles Branch held a highly successful 19th Annual Educational Session at the Los Angeles Break-

fast Club on March 19. The program consisted of four papers on timely plating shop subjects, each followed by a period of open forum discussion.

With approximately 75 in attendance, President *Frank Bunker* opened proceedings at 10 a.m. Librarian *Ed George* introduced as the first speaker *Gilbert Extale*, plant chemist of the General Electric Company, Ontario, Calif. Mr. Extale's talk was on "Disposal of Plating Room Wastes," a subject which he presented from the standpoint of a practical technician.

Elbert Marcum, technical service representative of the DuPont Company then offered a paper on "The Diaphragm System to Eliminate Roughness in Copper Plating."

Following a noon-day luncheon, the technical discussions were resumed at 2 p.m. The opening speaker at this session was *Dr. T. K. Cleveland*, of San Francisco, Vice President of Research and Development for the Philadelphia Quartz Co. of California. His subject was "Cleaning With Sodium Metasilicate and Sodium Sesquisilicate Prior to Electroplating." The fourth paper given was by *M. H. Orbaugh* of the Bone Engineering Co., Glendale, Calif., on "Hard Nickel Plating."

An exposition of plated products and plating room equipment and supplies was held in conjunction with the educational sessions. Participating in this exhibit were such firms as the *Barber-Webb Co.; J. J. Sieffen Co.; Oakite, Inc.; S. & M. Lamp Co.; Bowman Chemicals;* and *A. J. Lynch Co.*

The dinner dance in the evening attracted an attendance of some 350 members, guests and their ladies.

ASTM

Committee B-8 on Electrodeposited Metallic Coatings

Committee B-8 on Electrodeposited Metallic Coatings and its subcommittees met for two days in Chicago during A.S.T.M. Committee Week.

The committee voted to recommend adoption as standard of the *Recommended Practices for Chromium Plating on Steel* (*B* 177) and on *Preparation of Low-Carbon Steel for Electroplating* (*B* 183). A new recommended practice for *Preparation of High-Carbon Steel for Electroplating* will be recommended as tentative by the committee in June. The specifications for *Electrodeposited Platings of Zinc* (*A* 164) *and Cadmium* (*A* 165) *on Steel* are being amended and retained as tentative. The same action was taken in the specification for *Chromate Finishes on Electrodeposited Zinc, Hot-dipped galvanized, and Zinc Die-cast Surfaces* (*B* 201).

During the meeting, *H. A. Pray* of Battelle Memorial Institute presented, on behalf of the Subcommittee on Performance Tests, a report on Atmospheric Exposure of Electroplated Coatings on Steel. This was discussed by the committee and will be appended to the committee's annual report.

Considerable activity was also noted by the subcommittees on Conformance Tests, Electroplating Practice and on Supplementary Treatments for Metallic Coatings. At the meeting of the last-named subcommittee, representatives of the Navy Department and of the American Society of Refrigerating Engineers presented special problems on

which help of the committee was solicited. In both cases, steps were taken to initiate work expected to help find an answer to these problems.

Officers of Committee B-8 are:

Chairman—*C. H. Sample*, The International Nickel Co., New York, N. Y.

Secretary—*R. B. Saltonstall*, The Udylite Corp., Detroit, Mich.

NATIONAL ASSOCIATION OF METAL FINISHERS

Board of Directors Meet in Cincinnati

The 1949 Spring Meeting of the Board of Directors of the *National Association of Metal Finishers* was held in Cincinnati, Ohio, on Monday, March 7, 1949.

The meeting was attended by President *Paul Henning* of Detroit; 2nd Vice President *Harold E. Coombes* of Pasadena, California; 3rd Vice President *D. J. Griffin* of Birmingham, Alabama; Treasurer *W. O. Zinn* of Chicago; Directors *C. R. Crawford*, Chicago; *John Hilfinger*, Toledo; *Julian Nelkin*, New York; *Philip Sievering, Jr.*, New York; *F. A. Truden*, Nashville, and *Wm. F. Walton*, Attleboro, Mass.; Representatives of local associations, *Adolph Bregman*, New York; Chairman *J. P. Malooly* and Executive Secretary *J. George Schneider* of Chicago Electro-Platers Institute. Industry members present were *W. B. Knight*, Detroit; *H. J. Seigal*, St. Louis; *V. E. Schuman*, Toledo; *Ralph Timberlake*, Kansas City, Mo., and *Raymond M. Shock*, Executive Secretary of the National Association.

The 4th Annual Meeting of the National Association of Metal Finishers will be held in conjunction with the annual convention of the AES in Milwaukee, Wisconsin, the latter part of June.

Mr. Ralph W. Timberlake of the Bar-Rusto Plating Corporation of Kansas City, Mo., was elected to the Board of Dierctors, replacing *Mr. J. L. Baar* of that city.

NATIONAL ASSOCIATION OF METAL FINISHERS

Masters Electroplating Association

The latest (March) Bulletin of the Masters Electroplating Ass'n shows that the rate of operations in job plating shops in and around the New York area is 47%, as of March 26th. Sixty-six shops were polled in this report, and the figure compares with a rate of operations of 52% for the same period last year.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Presentation of the 1949 *Willis Rodney Whitney Award* to *Dr. R. B. Mears*, manager of the research laboratory of *Carnegie-Illinois Steel Corp.*, Pittsburgh, Pa. and the 1949 *Frank Newman Speller Award* to *F. L. LaQue*, in charge of the corrosion engineering section, *International Nickel Co., Inc.*, New York, was made Wednesday April 13th at the annual banquet of the *National Association of Corrosion Engineers* at the Netherland Plaza Hotel in Cincinnati. Mr. Mears is the incoming and Mr. LaQue, past president of the association.

The awards, named after *Willis Rodney Whitney*, who was first to receive the award in recognition of achievement in the field of corrosion science, and after *Frank Newman Speller*, first to receive the award in

recognition of achievement in the field of engineering, are made annually to the persons voted best qualified in the two fields defined.

Determination of those to receive these awards is made by ballot among members of the association. The awards committee for 1949, headed by *Walter F. Rogers* of the Gulf Oil Corp. was composed of *Dr. F. N. Speller*, Pittsburgh, Pa.; *Dr. A. Wachter*, Shell Development Co., Emeryville, Calif.; *Dr. H. J. McDonald*, Loyola University, Chicago, Ill.; *Dr. I. A. Denison*, U. S. Bureau of Standards, Washington, D. C.; *L. G. Vande Bogart*, The Crane Co., Chicago, Ill.; *J. C. Stirling*, Stanolind Pipe Line Co., Tulsa, Okla.; *Sam Tour*, Sam Tour Co., New York City; *Dr. T. J. McKenzie*, American Cast Iron Pipe Co., Birmingham, Alabama; *Dr. J. M. Pearson*, Sun Physical Laboratory, Newton Square, Pa.

In 1948 the Whitney award was given to *Ulick R. Evans*, Reader of Science, Cambridge University, Cambridge, England, and the Speller award to *John M. Pearson*, director physical division, Research and Development Division, Sun Oil Co., Upland, Pa.

AMERICAN ZINC INSTITUTE

Edward H. Snyder, Salt Lake City, was elected president of the American Zinc Institute at the organization's thirty-first annual meeting in St. Louis April 11-12. Snyder, who is president of Combined Metals Reduction Company, succeeds *Howard I. Young*, St. Louis, who announced previously that he would terminate his service as an officer of the institute after serving 14 years as its president and 17 years as treasurer. Young is president of American, Zinc, Lead and Smelting Company in St. Louis.

Three new vice-presidents were elected: *Clarence Glass*, Anaconda Sales Company, New York City; *George Mixter*, U. S. Smelting, Refining and Mining Company, Boston; and *Raymond F. Orr*, Athletic Mining and Smelting Company, Fort Smith, Ark.

Erle V. Daveler, of the New York City office of American Zinc, Lead and Smelting Company was elected treasurer. *Ernest V. Gent*, New York City, was re-elected executive vice-president and secretary.

In addition to Mixter and Orr, the following were elected directors: *A. E. Bendelari*, Lexington, Ky.; *O. W. Bilharz*, Bilharz Mining Company, Baxter Springs, Kan.; *C. M. Chapin Jr.*, St. Joseph Lead Company, New York City; *M. L. Harvey*, New Jersey Zinc Company, New York City; *W. B. Porter*, Hegeler Zinc Company, Danville, Ill.; *S. H. Levison*, American Smelting and Refining Company, New York City; and *R. G. Kenly*, New Jersey Zinc Company, New York City.

NEW BOOKS

Metal Finishing Manual of the National Association of Metal Finishers

National Ass'n of Metal Finishers, Inc., 2237 Dime Bldg., Detroit, Mich. Price $20.00 per copy.

This manual, which is intended

primarily for the job plating shop, is compiled in the form of data sheets, and contains a wealth of information useful to the job shop operator in calculating costs and selling prices. Present plans are to add supplemental sheets to the manual from time to time as the need arises. In addition to the costing and pricing information, there is a large amount of technical data intended to alleviate the tedious calculations continuously required in the operation of a plating shop. Of particular value are the figures for deposited metal cost per ft.^{2} at various metal prices; power costs for various plating thicknesses of the commonly deposited metals; labor costs for the "fringe" benefits usually asked for in labor contract negotiations; deposition rate tables for common plating baths; and the unusually complete compilation of government and commercial specifications for thickness and evaluation of plated items.

At a time when plating and finishing costs must be carefully watched, this manual provides the job shop operator with information that details proven means of selling his services and operating his shop in a manner that is fair to both his customers and to himself. Buyers of plated goods would also profit from a careful study of the data contained in this manual.

W. A. R.

Properties of Soft Solders and Soft Soldered Joints

By J. McKeown. Published by British Non-Ferrous Metals Research Ass'n, Euston St., London NW 1, Eng. Price $4.00. *116 pages.*

The tin shortage during the recent war stimulated the B.N.F.M.R.A. to researches on solders of lower tin content.

Information was lacking on the mechanical properties of the tin economy solders and joints made in them. To fill this gap, a wide variety of tests were carried out over a series of temperatures, including tests on the creep properties of joints made wi a range of solders. In addition, comparison was made (by soldering, area-of-spread and capillary penetration tests) of high-tin and tin-economy solders. The hot tearing of solders was examined in order to define suitable compositions for the avoidance of this trouble; and investigation was made of the soldering of aircraft oil-coolers by lead-rich solders.

This experimental work and the conclusions drawn from it are described in the present volume. Dr. John McKeown (head of the Association's Mechanical Testing Section) led the team concerned with this war-time research.

Trade-Marks

By H. Bennett. Published by Chemical Publishing Co., Brooklyn, N. Y. Price $10.00. *479 pages.*

Buyers, sellers, manufacturers, lawyers, chemists, engineers and many others will welcome this book, which outlines the principles of trade-mark selection and make-up. In addition the book contains a comprehensive alphabetical listing of trade-marked chemicals, textile specialties, plastics, synthetic rubbers, alloys, and commercial products, showing the chemical composition and manufacturers name.

News from California

Barber-Webb Incorporates

The Barber-Webb Company, 8686 *Rheem Avenue, South Gate, Calif.,* announces that it has incorporated and henceforth operations will be conducted under the name—*The Barber-Webb Company, Incorporated.*

Mr. Allyn E. Webb has been made Vice President. Mr. Webb has had wide experience in the field of corrosion control during the past ten years and has been Manager of The Barber-Webb Company since its inception in 1945. *Mr. Clinton C. Scott* becomes Sales Manager. Mr. Scott has been active in sales work with The Barber-Webb Company since 1946, and will continue to devote his entire energies to sales matters, including supervision of that department. *Mr. C. P. Simon* continues in charge of Contract Estimating and Purchasing. Plant and field installations will continue under the direct supervision of *Mr. E. D. Gregory. Mr. Edwin C. Schreihart* is in charge of Research and Experimental Departments. *Mr. William C. Pearce* will head up New Product Development and Advertising.

The company is enlarging its plant space from the present 12,000 to 24,000 square feet and will continue its field operations throughout the Pacific Coast and adjacent inland states.

Barber-Webb's primary function is to develop and install plastic and other materials used to combat the corrosive effects of acids, alkalis, abrasion and elevated temperatures. The company distributes and also installs both acid and carbon brick.

Barber-Webb is the local distributor for B. F. Goodrich Company's Koroseal Industrial Products and functions in the same capacity for a number of other manufacturers of plastic materials.

A visitor to Los Angeles in March was *Wilfred S. McKeon,* president, Sulphur Products, Inc., Greenburg, Pa., on a combination business and pleasure trip. His schedule was delayed somewhat by an attack of grippe which overtook him in Los Angeles. Mr. McKeon left for the East on April 1, making stops enroute at Phoenix, Ariz., El Paso and Dallas, Tex., and planned also to visit his sister in Marshall, Tex., and later to address the AES Branch of Atlanta, Ga.

Among members of the plating, plating equipment and supply industry from the middle-west and east who attended the 6th Annual Western Metals Congress at Los Angeles April 11 to 15, were the following:

George Carlson, president, Acme Mfg. Co., Detroit, and *Mrs. Carlson,* accompanied by *John Hackert,* plant superintendent, and *Mrs. Hackert.*

B. B. Button, sales manager of the Metal Industries Department, and *S. E. Alvis,* sales manager, Industrial Maintenance Department, Diversey Corp., Chicago.

J. C. Stearns, product manager, and

William Loose, sales manager, Midland, Mich., representing Dow Chemical Co.

T. H. Wickenden, vice president, International Nickel Co., New York; and *Dr. V. N. Krivobok*, *K. M. Spicer*, *F. R. Bailey*, and *W. Adamson*, metallurgists, all of New York.

Arthur W. L'Hommedieu, president, L'Hommedieu & Sons Co., Chicago.

W. E. Thomas, vice president and *R. O. Schiebel*, mid-west manager of magnaflux Corp., Chicago.

I. W. Stanton, *W. L. Hardy* and *B. G. Ebbeson* of the engineering department, Norton Company, Worcester, Mass; and *C. W. Jinnette*, regional manager for the Norton Company at Detroit, Mich.

A. H. Behnke, president, *R. B. Robinson*, general sales manager, and *T. A. Welch*, sales engineer, of Production Machine Co., Greenfield, Mass.

Aladdin Mfg. Co., Burbank, Calif., has expanded its facilities with the addition of a new eight foot copper solution tank and a new nickel tank. Re-opened several months ago after a period of inactivity, the plant is being operated both as a job shop and for finishing items of its own manufacture. Equipped with bright nickel, bright copper and other facilities, the shop represents an investment of approximately $35,000. *Robert Gray* is general manager.

A new job shop for polishing and buffing, mainly on die-cast aluminum, has been opened by *H. B. Larson* at 705 Jones Street, Berkeley, Calif., under the name of *Acme Plating and Polishing Co.* The enterprise represents an investment of $10,000 in building and equipment.

Cast Aluminum Products Mfg. Co., San Rafael, Calif., has expanded its buffing and polishing facilities by the addition of two new polishing lathes and auxiliary equipment, for use in the processing of electric saws. *H. L. Baslee* and *Charles Wagners* are co-owners.

Letter to the Editor

Editor
Metal Finishing
11 West 42nd Street
New York, New York
Dear Editor:

I have read with considerable interest the article by MacMullen and Ozar entitled "Sodium Silicates in Metal Cleaning" that appeared in the April 1949 issue of "Metal Finishing."

In the main I agree with them, particularly with the statement that silicates are an important constituent of

most of the alkaline cleaners on the market. I agree that the use of silicates, particularly metasilicate, greatly enhances the detergent ability of alkaline cleaning formulations for metals, but our tests do not indicate that sodium silicates are advantageous in cleaners for zinc base die castings. We have done a great deal of work on the formulation of alkaline cleaners for zinc base die castings and have come to the conclusion that anodic cleaning is greatly preferred over cathodic cleaning. In conjunction with our cleaning tests, we always make plating tests, and after the plate has been applied, we bake the castings for different periods of time at 300° F. to determine whether blisters will form. In every test that we have made, the use of sodium metasilicate in the cleaning formulation tended to increase blistering after baking of the zinc base die casting.

We note that the authors refer to an article by Hazel & Stericker, and the present authors claim that Hazel & Stericker reconcile conflicting reports on the use of silicate cleaners. Frankly, I believe that this article did nothing of the sort. If you will read the article by Hazel & Stericker, you will note that no plating tests were made on the casting being cleaned. They confine their attention to the surface effects on sheet zinc and zinc alloy die castings, noting whether the surface was darkened or whether precipitates formed. What these authors should have done was to run plating tests with the solutions that gave no noticeable deposits on the zinc alloy die castings, bake the castings and then compare the extent of blistering for various cleaning materials used as well as with different operating conditions.

Our tests indicate that there is the formation of some type of silicious material on the surface of the zinc base die casting for most zinc base die casting cleaner formulations that contain silicates, largely because the pH of these solutions must be lower than those solutions used for cleaning of steel. If any readers of "Metal Finishing" have done careful work evaluating the various alkalis and have studied the effects of silicates in which their tests involved plating operations followed by baking, I believe they would be worth calling to the attention of the readers of "Metal Finishing." It is not sufficient just to make plating tests to determine whether the surface has been properly prepared. It is necessary that baking be done of the zinc base die casting.

The authors state that when sodium metasilicate solutions are used electrolytically, films may form on both the cathode and the anode, and they state that these films are readily soluble in subsequent acid dips and, therefore, represent no plating problem. I do not believe that this statement is completely true. If sodium metasilicate is used without the presence of caustic soda, films of a silicious material will deposit when the work is cleaned cathodically, which can not be rinsed off and which will not disperse in strong sulphuric acid or hydrochloric acid solutions. Such films can only be removed by means of hydrofluoric acid dips which indicates that they are silicious-type materials. If these films are not removed, they can actually cause considerable discoloration of the plate that is deposited, particularly bright nickel. Such films do not show up in cleaners designed for the cleaning of steel because of their high alkalinity but they are evident in milder cleaners used for cleaning of brass when the cleaners contain sodium metasilicate. In some cases, the films may also decrease the adherence of the electrodeposit.

I would like to repeat that I believe that in most cases the use of the proper silicate is advantageous but there are certain precautions that must be taken in the formulation of certain types of cleaners, and, in addition, the proper acid dip must be used to remove the films deposited in mild alkaline cleaners containing silicates.

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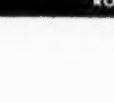

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